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WILSON (G. F.). **Fruit Pests : their Effect and Detection.**—*J. R. hort. Soc.* **60** pt. 12 pp. 536–544, 8 pls. London, December 1935.

The ways in which insects attack fruit trees and bush fruits, and the kinds of injury they cause to the root, stem, foliage, leaf, flower, fruit and seed are discussed. A general outline is also given of the life-histories and methods of feeding of the main insect groups. The mouthparts of haustellate and mandibulate insects are briefly described, and notes are also given on the ovipositors of Tenthredinids and Trypetids, gall-formation by Cynipids and Cecidomyiids, and the growth of sooty moulds on the honeydew execreted by various Homoptera. A list is appended of some insect pests of hardy fruits in Britain, grouped according to the types of their mouth-parts and the part of the plant attacked.

KEMPER (H.). **Zur Lebensweise des Teppichkäfers und seine Bekämpfung. Ueber den Messingkäfer und seine Bekämpfung.** [The Life-history and Control of the Carpet Beetle. The Control of *Niptus hololeucus*.]—*Z. GesundhTech. Städtehyg.* **27** no. 8–12, pp. 355–358. Berlin, 1935.

In Germany the adults of the carpet beetle, *Anthrenus scrophulariae*, L., which often occur in the open on flowers, lay up to 36 eggs in April. The larvae, which attack carpets, blankets, furs, feathers, etc., hatch in late May or early June and pupate in the following February. Pupation often takes place in cracks in the floor under carpets. Oviposition can be prevented by cold storage or packing in well-closed boxes with naphthalene. Larvae and eggs in clothing may be brushed or beaten off, or destroyed by dipping in boiling water or strong lye. If fumigation chests are available, carbon tetrachloride at the rate of 0·5 fl. oz. per cu. ft. is effective.

All stages of *Niptus hololeucus*, Fald., are briefly described. A female lays 15–40 eggs singly at intervals of days. Most of the eggs fail to develop. The larvae, which hatch in 11–20 days at room temperature and 26–30 days at 15°C. [59°F.], feed on cereal products and on all kinds of vegetable and animal material. Well-fed larvae moult 3 times and badly-fed ones 4 times. They require 16–20°C. [60·8–68°F.] for development, and with 4 moults 140–200 days are necessary. The pupal stage lasts 14–22 days. In Germany one generation a year is the rule, two being exceptional. Combative measures include strict cleanliness and burning infested material, or sterilising it in boiling water by heating to at least 60°C. [140°F.] or by fumigating with carbon tetrachloride at the rate of 0·1–0·3 fl. oz. per cu. ft. The adults may be caught behind furniture, etc., trapped in wet rags or killed by strewing insect powder in their retreats. For fumigating entire rooms T-gas (ethylene oxide and carbon dioxide) or Zyklon B may be used.

SCHWARZ (L.). **Einige Beobachtungen über Hausbock.** [Some Observations on *Hylotrupes bajulus*.]—*Anz. Schädlingsk.* **11** no. 12 pp. 133–136, 9 figs. Berlin, December 1935.

These observations on *Hylotrupes bajulus*, L., were made when breeding from adults collected in July and August 1935 at Hamburg. The females died 1–7 days after oviposition. At room temperature the eggs hatched within 19 days, and at 30°C. [86°F.] in about 6 days.

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In pine the larval bore-holes and the exit-holes of the adults were oval, this differentiating them from those of Anobiids or wood-wasps [*Sirex*]. Newly-hatched larvae bored readily when transferred to the timber of *Thuja*, pines and various deciduous trees.

LEHMENSICK (R.). **Beiträge zur Bekämpfung und Begutachtung der Dörrobstmotte** (*Plodia interpunctella*) **und der Kakaomotte** (*Ephestia elutella*). [Contributions to the Control and Certification of Infestation by *P. interpunctella* and *E. elutella*.]—*Anz. Schädlingsk.* **11** no. 12 pp. 137–139, 7 refs. Berlin, December 1935.

The author describes observations in Germany on an infestation by *Plodia interpunctella*, Hb., and *Ephestia elutella*, Hb., of chocolate pralines with a filling of ground currants and dried plums. The larvae were found between the chocolate coating and the tinfoil wrapping. Moths of both species were abundant in the store room of the factory, which contained cases of dried currants, plums, etc., but the plums were not attacked. Currants in damaged cases were infested, but not those in sound ones. On intact currants, the larvae of both species developed very slowly, many died because they were unable to pierce the skin and the others after 7–8 weeks were as small as when newly hatched ; but those placed on praline filling produced adults in 52 days, including a pupal period of 12 days, at room temperature in August and September. The infestation of the pralines must have resulted from oviposition on them when drying and when stacked in the tinfoil wrappings. It was found that the larvae penetrated folds in the tinfoil. Larvae of *P. interpunctella* died when placed on confectionery completely coated with chocolate, being unable to subsist on the coating or penetrate through it, so that an unbroken coat of fair thickness should protect the filling against this species if not associated with *E. elutella*.

Fumigation of the cases of dried fruits with T-gas (ethylene oxide and carbon dioxide) and screening of the drying rooms appeared to give satisfactory control.

HAHMANN (K.). **Eigenartige Kohlpflanzenbeschädigung durch Rüsselkäfer.** [A peculiar Injury to Cabbage by Weevils.]—*Anz. Schädlingsk.* **11** no. 12 p. 142. Berlin, December 1935.

In June 1935 *Barypithes mollicomus*, Ahr., which lives in forest litter and is not a forest pest, attacked cabbage near Hamburg on land that had previously been a nursery of silver firs [*Abies*], up to 50–60 weevils being found at the base of each stalk, which they gnawed until the plant fell over. They also gnawed the bark of remaining young silver firs and shoots of gooseberry and currant. A pyrethrum dust proved effective against them.

EXT (W.). **Massenauftreten der Kohlrübenblattwespe.** [An Outbreak of the Swede Sawfly.]—*Wbl. Landesbauernsch. Schles.-Holstein* no. 28, 13th July 1935. (Abstr. in *Anz. Schädlingsk.* **11** no. 12 p. 143. Berlin, December 1935.)

A serious infestation of swedes by the larvae of *Athalia rosae*, L. (*colibri*, Chr.) occurred in Schleswig-Holstein in July 1935, but was checked by spraying with an arsenical.

Ciślik (W.) & Kawecki (Z.). **L'apparition en Pologne de l'*Aphelinus mali* Hald.**—*C. R. Acad. Cracovie* no. **9** p. 5. Cracow, 1935.

Aphelinus mali, Hald., appeared, without having been artificially introduced, in October 1935 in several districts in Poland. Its host, *Eriosoma lanigerum*, Hsm., is widely distributed on apple in that country.

Paillot (A.). **Note préliminaire sur les Microlépidoptères nuisibles au pommier.**—*Rev. franç. Ent.* **2** fasc. 3 pp. 123–129. Paris, November 1935.

Observations were made during 1933 and 1934 on the bionomics of a number of Lepidoptera attacking the foliage, flowers and shoots of apple in the Loire district, of which the Tortricids, *Eucosma* (*Spilonota*) *ocellana*, Schiff., *Argyroploce variegana*, Hb., *Tortrix* (*Cacoecia*) *rosana*, L., *T.* (*Pandemis*) *ribeana*, Hb., and *Peronea contaminana*, Hb., the Pyralid, *Phycita spissicella*, F., and the Tineids, *Recurvaria nanella*, Hb., *R. leucatella*, Cl., and *Chrysoclista* (*Blastodacna*) *putripennella*, Zell., were the most common.

The adults of *Eucosma* occurred in June. The eggs were laid singly, usually on the upper surfaces of the leaves, and hatched in about 9 days. The larvae usually fed on the parenchyma, sheltering in small cases between two leaves spun together. After hibernating from the end of September in cocoons near flower buds, they resumed activity in spring when the buds opened, and often occurred inside flower trusses, together with larvae of *A. variegana* and *Recurvaria*. They pupated among clusters of dry leaves spun together, or inside flower trusses, and the adults emerged in about a fortnight. The larvae were parasitised by the Ichneumonid, *Pristomerus vulnerator*, Panz., the Pteromalid, *Pseudomicromelus* (*Pteromalus*) *deplanatus*, Nees, and the Eulophid, *Euderus albitarsis*, Zett. *A. variegana* was on the wing in the second half of May. Eggs were laid singly, chiefly on the underside of the leaves, and hatched in about 8 days. After feeding on the parenchyma of the very young leaves for about 15 days, the larvae spun cocoons in the crevices in the bark of young shoots and remained inactive until the following spring, when they penetrated into the developing flower buds or shoot buds. Pupation took place among clusters of leaves or in flower trusses, and the adults emerged in about 15 days. The Braconid, *Macrocentrus abdominalis*, F., and an Encyrtid, *Copidosoma* sp., were reared from the larvae. *T. rosana* overwintered in the egg stage. The larvae of this species and of *T. ribeana* lived and pupated among leaves which they webbed together, and the adults first appeared in late May or early June.

The adults of *Phycita spissicella*, which has not previously been recorded as a pest of apple, appeared in the second half of June. The larvae, which are briefly described, at first lived inside silken cases between two leaves joined together and caused damage almost identical with that done by *E. ocellana*. In October they entered hibernation in cocoons in crevices in the bark, and in spring resumed feeding inside small clusters of leaves, where they eventually pupated. The pupal stage lasted about 20 days.

The adults of *Recurvaria nanella* and *R. leucatella*, the characters distinguishing which are pointed out, were most numerous between 4th and 11th June. Eggs were laid singly on the underside of the leaves,

usually along the veins. The larvae mined inside the leaves till the beginning of October, when they emerged and spun cocoons on young shoots or in cracks in the bark. At the end of March they penetrated and tunnelled into the buds (chiefly the flower buds) ; usually they were protected by silken cases. Pupae were found inside the clusters of flowers or leaves from the middle of May. The only parasite obtained was the Bethylid, *Bethylus fuscicornis*, Jur.

The damage caused by *Chrysoclista putripennella* is often attributed to frost or other causes. In 1933 the moths occurred from 12th May till July. The bionomics are similar to those recorded from England [*R.A.E.*, A **19** 135] for *C. atra*, Haw., which the author considers the same species [*cf.* **21** 427]. The most important injury was caused to clusters of flowers in April. The parasites reared were the Ichneumonid, *Ephialtes crassiseta*, Thoms., the Encyrtid, *Copidosoma woronieckae*, Now., and a Eulophid, *Elachertus* sp. Handpicking and destroying the infested shoots is the only suitable control measure.

A single application on 24th March of tar distillate (10 per cent.) in Bordeaux mixture (2 per cent. copper sulphate and 3 per cent. lime) killed the hibernating larvae of *A. variegana*, *Eucosma ocellana*, *R. nanella* and *R. leucatella* when their cocoons were wetted by the spray, but did not affect those of *P. spissicella* or *Chrysoclista putripennella*. Spring treatments with arsenical sprays are effective against the larvae injurious to the leaves, but those of *Recurvaria*, since they penetrate into the flower buds, and of *C. putripennella* are inaccessible.

KAUFMANN (O.). **Beobachtungen und Versuche über die Rübenwanze** *Piesma quadrata* **Fieb.** [Observations and Experiments on the Beet Leaf Bug, *P. quadrata*.]—*Arb. physiol. angew. Ent. Berl.* **2** nos. 3–4, pp. 204–212, 225–253, 3 figs., 7 refs. Berlin, 20th September & 21st December 1935.

The results are given of observations on *Piesma quadrata*, Fieb. (beet leaf bug) carried out in German Silesia in 1933 and 1934 and based on Wille's monograph [*R.A.E.*, A **17** 640]. The following is taken largely from the summary : The migration of the bugs to their winter quarters began in July and extended into October. Winter quarters were dry, warm and exposed to sunshine. In the case of ground beneath trees, a southern aspect was preferred, and such places often harboured hundreds of bugs. Migration to the beet fields occurred in large numbers from mid-April onwards, usually by flight. Its duration was variable, as it began when the temperature rose above 20°C. [68°F.] and was interrupted by a fall of temperature or by rainy weather. It was found that boards coated with adhesive and placed in the beet fields are the best guide to the progress of migration. If no bugs are caught at over 20°C., the winter quarters are empty and it is time to plough under the beet plants sown as traps. Oviposition can begin within a few days of the appearance of the first bugs and is no guide to the date for this measure. In the beet fields, the eggs are laid on beet, weeds and even pieces of straw, wood, etc., and, owing to overlapping of the two generations, can be found from April to early September. Some adults of the overwintered generation were still present on 11th June 1934 when the first young adults appeared. The bugs were increasing during the period of this work, the approximate numbers of eggs per beet plant in the observation plots being

300 in 1933 and 500 in 1934. No insect or fungous parasites were observed, but spiders preyed on the nymphs and adults.

In the districts where *P. quadrata* is a pest, it breeds on wild Chenopodiaceae, especially *Chenopodium glaucum* and *C. album*. On *Chenopodium* it was never found to become infected with the virus of beet leaf crinkle. Some of the old bugs on *Chenopodium* harboured the virus, but it appeared to be destroyed in plants of this genus for no typical symptoms of the disease appeared in them. Neither bugs fed on them nor juice from them was able to infect beet. Adults of both sexes from beet were longer and narrower than those from *C. glaucum*, but the differences do not warrant separation into races.

TELENGA (N. A.). **Neue und weniger bekannte palaearktische Braconiden (Hym.).** [New and less well known Palaearctic Braconids.]—*Arb. physiol. angew. Ent. Berl.* **2** no. 4 pp. 271–275. Berlin, 21st December 1935.

This paper includes descriptions of four Palaearctic Braconids, two of which are new. Of these, *Phaenocarpa psalliotae*, sp. n., was reared from Dipterous larvae in mushrooms in Germany; the hosts of the others are not given. A list by H. Sachtleben of 24 species bred in Germany with their hosts is appended.

BOVEY (P.). **L'Anthonome d'hiver du poirier** (*Anthonomus pyri* **Kollar**=*cinctus* **Redt.**).—*Rev. hort. suisse* 1935 no. 2, reprint 8 pp., 14 figs., 4 refs. Geneva, February 1935. [Recd. December 1935.]

An account is given of the bionomics of *Anthonomus piri*, Koll. (*cinctus*, Redt.), in French Switzerland and the damage it causes to pears [*cf. R.A.E.*, A **18** 515; **19** 422, etc.]. The characters distinguishing it from *A. pomorum*, L., and *A. spilotus*, Redt., which sometimes occur on pear but cause little injury, are briefly described. Although it was recorded in Switzerland in 1898, it did not attract much attention until the last 2 or 3 years, when it caused considerable damage in some localities. The first adults to come out of aestivation were observed on 25th September in one locality and at the end of October in another. Eggs are sometimes laid in the leaf buds. Oviposition begins at the end of September or beginning of October and continues into the autumn. The pupal period lasts 8–10 days. In the laboratory adults emerged between 14th May and 10th June in 1934. Of 514 flower buds collected at random on 20th December 1934 in one locality, 314 contained eggs or larvae, 110 showed feeding punctures made by the adults, and only 90 were free from injury.

In comparative tests, sprays containing a tar distillate (soluble carbolineum) or an emulsified schist oil applied as repellents at the end of September 1934 were not very effective. Buds that have dried up or show oviposition punctures should be collected and burnt in April before the adults emerge.

NEWMAN (L. J.). **Descriptive Account of the Codlin Moth, together with Notes on its Control.**—*J. Dep. Agric. W. Aust.* (2) **12** no. 3 pp. 264–277, 1 pl., 6 figs. Perth, W.A., September 1935.

Cydia pomonella, L., is a serious pest of apples, pears and quinces in all States of the Australian Commonwealth except Western Australia,

where it does not occur. In view, however, of the danger of its spread to that State, an account is given of its bionomics and measures for its control, and all stages are described to facilitate identification.

NEWMAN (L. J.). **Fruit Fly.**—*J. Dep. Agric. W. Aust.* (2) **12** no. 3 pp. 323–324. Perth, W.A., September 1935.

The results are given of experiments carried out from 25th January to 1st July 1935 in Western Australia to test the value of five baits and four types of traps hung in fruit trees to catch the Mediterranean fruit-fly [*Ceratitis capitata*, Wied.]. Of the baits, a mixture of 8 oz. pollard and 6 oz. borax in 1 gal. water [*cf. R.A.E.*, A **17** 105], and the standard bait of 1 part vanilla [synthetic essence] and 1 part household ammonia in 26 parts water [*cf.* **22** 88] were much inferior to any of three proprietary baits. Of these Clensel (1 : 30) [*cf.* **19** 647] caught 2,484 flies (60 per cent. were females), undiluted Lura Bane caught 1,672 (73 per cent.) and Beeco (1 : 40) caught 1,060 (64 per cent.) in the best trap over the entire period. In May and June, however, an improved type of Beeco caught more flies than Clensel. A "slip on" trap, which was made locally and is not described, was the best.

JENKINS (C. F. H.). **The Bdellid Mite** (*Biscirus lapidarius* **Kramer**).—*J. Dep. Agric. W. Aust.* (2) **12** no. 3 pp. 342–347, 3 figs., 3 refs. Perth, W.A., September 1935.

An account is given of observations on *Biscirus lapidarius*, Kramer, carried out in 1934 and 1935 in several localities in Western Australia, where it was found to exercise a definite control of the lucerne springtail [*Smynthurus viridis*, L.] on clover [*cf. R.A.E.*, A **21** 408; **22** 313]. The suggestion that the eggs of the mite aestivate during the dry summer period was confirmed in experiments in which eggs collected in October 1934 from the under side of pieces of timber and kept in a lamp glass sealed with cellophane until the advent of the winter rains in 1935 hatched in 10 days when moistened on 14th April. In tests with eggs laid in May or June, the incubation periods were 11 days for those kept on moist earth, 24 for those on sand that was alternately moistened and allowed to dry, and 43 at a rather lower temperature for those kept on moist earth for 7 days, allowed to dry for 7 days and then replaced on moist earth. Some of the mites died in the eggs in the last test, and it appeared that after a certain stage of development has been reached, dry conditions are fatal. The eggs, which are described, are scattered singly or in clusters on the under side of fallen leaves, bark and timber, and sometimes on charred logs. In the laboratory, the average number of eggs laid by a female was 20; one dissected individual contained what appeared to be about 100 immature eggs, which suggests that several batches may be deposited. In the field, the adults were observed to feed on small insects other than *Smynthurus*, apparently Psocids. Moisture is essential for them. Currie's observation that they do not feed on eggs of *Smynthurus* [**22** 313] was confirmed in experiments.

SUMMERVILLE (W. A. T.). **Pink Wax Scale.**—*Qd agric. J.* **44** pt. 4 pp. 404–408 2 figs. Brisbane, October 1935.

Ceroplastes rubens, Mask., is abundant on the coast lands of Queensland and attacks *Citrus* and many other plants. Mandarin and orange

are preferred. It infests the leaves and twigs, and the sooty mould associated with it frequently covers the fruit. The young emerge over wide periods of time [*cf. R.A.E.*, A **24** 35] and move about the tree for several days before settling. In this stage they are easily dislodged, and distributed by the wind to neighbouring plants. Insecticides [*cf.* **22** 712] should not be applied until migration has ceased owing to the danger of subsequent reinfestation. Sooty mould can be removed from the fruit by immersing it for about a minute in a solution of $\frac{1}{4}$ lb. boracic acid and $\frac{1}{4}$ lb. chloride of lime per gal. water, and afterwards rinsing thoroughly.

EVANS (J. W.). **The Apple Leaf-hopper.**—*Tasm. J. Agric.* **6** no. 4 pp. 155–157, 1 fig., 2 refs. Hobart, 1st November 1935.

In view of an investigation on *Typhlocyba froggatti*, Baker (*australis*, Frogg.) (apple leafhopper) that is being undertaken in Tasmania, data on its bionomics and control in Australia and New Zealand [*R.A.E.*, A **18** 32; **22** 656] are reviewed.

ANDREWARTHA (H. G.). **Thrips Investigation. 7. On the Effect of Temperature and Food upon Egg Production and the Length of Adult Life of *Thrips imaginis* Bagnall.**—*J. Coun. sci. industr. Res. Aust.* **8** no. 4 pp. 281–288, 2 figs., 16 refs. Melbourne, November 1935.

Experiments on *Thrips imaginis*, Bagn. [*cf. R.A.E.*, A **23** 525] were made at Melbourne to determine the effect of temperature and food on the egg production and adult life. The insects used belonged to the same laboratory colony, and a saturation deficiency of 5 mm. was maintained throughout. Each test was conducted with 10–20 adult females kept singly in small glass phials loosely stoppered with cotton wool, in which they had been placed when ready to pupate.

Where temperature was the variable, the food consisted of an *Antirrhinum* stamen, which was renewed regularly and examined for eggs. At 8°C. [46·4°F.], 12·5°C. [54·5°F], 16°C. [60·8°F.], 20°C. [68°F.], and 23°C. [73·4°F.], the total numbers of eggs laid per female averaged 18·6, 191·9, 186·9, 207·2, and 251·7, the average lengths of life 251·3, 138·6, 54·9, 42·0, and 45·7 days, the daily egg production 0·08, 1·38, 3·39, 5·18, and 5·55, and the preoviposition periods (excluding that at 8°C.) 10·25, 4·85, 3·46, and 2·53 days. The results do not show a significant effect of temperatures above 8°C. on the total egg protion. Since the average length of life was $4\frac{1}{2}$ months at 12·5°C. and the winter temperatures around Melbourne are lower than this, *T. imaginis* is capable of overwintering in the adult stage so far as temperature is concerned. The rate of egg production and temperature show approximately linear relationship, and the zero of the curve is about 8·5°C. [47·3°F.]. The product of average preoviposition period and temperature above 8·5°C. was found to be approximately constant.

The addition of pollen to the food increased the average egg production from 19·8 to 209 (probably owing to the high protein content of the pollen), but decreased the average life from 72·6 to 52·1 days. Individuals that received only a leaf of *Trifolium repens* or of *Plantago lanceolata* lived for a relatively short time and laid practically no eggs.

The average lengths of life of males were 247·4 at 8°C. and 31·6 at 23°C.

MUGGERIDGE (J.). **Thrips : With special Reference to "the Greenhouse Thrips."**—*N.Z. J. Agric.* **51** no. 5 pp. 298–301, 3 figs. Wellington [N.Z.], 20th November 1935.

Brief notes are given on the bionomics of Thysanoptera and the types of injury they cause to plants, with particular reference to *Heliothrips haemorrhoidalis*, Bch., which has been recorded in New Zealand on *Citrus*, persimmon, apple, peach, the tung-oil tree [*Aleurites fordi*], *Rhododendron* and *Azalea*. This thrips is destroyed by heavy rain. A spray of 1 pint nicotine sulphate and 3 lb. soap in 100 gals. water is effective for control, but should be applied at intervals of 10–12 days, as it does not kill the eggs. Greenhouses can be fumigated with hydrocyanic acid gas [*R.A.E.*, A **22** 252].

ROBA (R.). **Catalogue systématique des insectes du caféier** (*Coffea* **sp.).** —*Ann. Gembl.* 1935 pp. 299–379, 190 refs. Brussels, August–October 1935.

A systematic list is given of the insects that attack coffee, showing their distribution, with references to a bibliography, which is appended, the parts of the plants they attack, and, in some cases, the character or extent of the injury caused.

KING (C. B. R.). **A further Trial with** *Trichogramma*.—*Tea Quart.* **8** pt. 3 pp. 140–147, 4 figs. Talawakelle, Ceylon, November 1935.

In a further experiment in Ceylon [*cf. R.A.E.*, A **22** 376], egg-masses of *Homona coffearia*, Nietn., parasitised by *Trichogramma evanescens*, Westw., were attached to tea bushes on 28th December 1934. From 5,000 to 20,000 parasites were liberated in each plot, and although the egg-masses were more abundant than in the previous year, in only one plot was none parasitised. On 16th January on one plot, 53 out of 313 egg-masses that had not hatched were parasitised, 7 of them to an extent of 90 per cent. and one completely. It was estimated that the first field generation comprised over 2,700 parasites, which was about 27 per cent. of the number liberated. On 5th February, of 10 egg-masses that had not hatched 3 were parasitised to a small extent, and the second field generation consisted of about 90 parasites, about 1 per cent of the number liberated. The decline in the number of egg-masses was so great that no further examinations were made. On 16th January it was found that some parasites had established themselves in egg-masses on the outer bushes of the plot. These egg-masses must have been parasitised on or before 9th January, as the time that elapsed between parasitism and the blackening of the egg (which was the sole criterion in making counts) was about 7 days. As the parasites began to emerge on 30th December, they had 10 days to reach the outer plants, and 18 egg-masses had been parasitised at a distance of 8 yds. or more from the point of release during that time. It is possible that some may have flown further than the maximum of $12\frac{1}{2}$ yds. recorded. They were fairly evenly dispersed radially from the point of release. The parasite entirely failed to control *Homona* because their life-cycles do not coincide and there is practically no overlapping of generations of the host, and no alternative hosts for the parasite. The life-cycle of *Homona* is 9–11 weeks in the field whereas that of the parasite is about 16–19 days. When egg-masses are scarce, the parasite, because of its relatively feeble flight, has great difficulty in finding hosts and so its

numbers are too few to control the next generation. There are well-marked periods during the year when very few egg-masses are laid and *Trichogramma* is unable to bridge these gaps because its life-cycle is too short. From observations made during 1932–35, generations of *Homona* occur at about the same times each year and are well-defined with hardly any overlapping.

Norris (D.), Glover (P. M.) & Aldis (R. W.). **Lac and the Indian Lac Research Institute.**—Cr. 4to, [5] iii+66 pp., 12 pls., 1 map, 2 graphs. Namkum, Ranchi, Indian Lac Res. Inst., 2nd edn, July 1935. Price *Rs.*2·8. [Recd. December 1935.]

This second edition [*cf. R.A.E.*, A **23** 248] contains various additions and emendations, among the most important being the addition of a chapter on what is meant by lac and shellac, which includes an account of the bionomics and cultivation of *Laccifer lacca*, Kerr. In addition to the pests of food-plants of the lac insect mentioned previously, *Hieromantis ioxysta*, Meyr., is reported damaging the leaves of *Schleichera trijuga*.

[Russell (T. A.).] **The Beet Fireworm.**—*Agric. Bull. Bermuda* **14** no. 10 pp. 76–77. [Hamilton] October 1935.

The early crop of beet in Bermuda is often completely destroyed by *Hymenia recurvalis*, F. (*fascialis*, Stoll). Dusting the beets with lead arsenate in the autumn of 1932 did not control the larvae but reduced their numbers. In 1933 damage was not serious and there was no great difference between treated and untreated plants [*cf. R.A.E.*, A **22** 253]. When beet is not available, the moths migrate to *Amarantus hybridus* and *Portulaca oleracea*, on which all stages are present in the late summer and autumn.

[Russell (T. A.).] **Diseases and Pests of the Bermuda Cedar.**—*Agric. Bull. Bermuda* **14** no. 12 pp. 93–95. [Hamilton] December 1935.

Juniperus bermudiana is seldom severely damaged by pests in Bermuda. *Chrysomphalus agavis*, Tns. & Ckll. [*cf. R.A.E.*, A **22** 305] and a Flatid of the genus *Ormenis* occur on the leaves, and the Pentatomid, *Banasa euchlora*, Stål, attacks the leaves and berries. The larvae of *Tibicen* (*Cicada*) *bermudiana*, Verrill, feed on the roots, and the adults injure the twigs by sucking the sap and laying eggs in the bark. The Cerambycid, *Oeme rigida*, Say (*linearis*, Harris), rapidly invades wounds in the trunks and branches, and the larvae make tunnels just under the bark. Trees that are to be used for posts should have the bark removed. Mites, probably *Eriophyes* sp., cause galls on the tips of the shoots, preventing their further growth. Another mite has been found in large numbers on the leaves.

Tenth National Shade Tree Conference Proceedings.—viii+153 pp. Pittsburgh, Pa, 1934. [Recd. December 1935.]

Four of the papers read deal with insect pests of shade trees in the United States. In Shade Tree Insects of the Middle West and their Control (pp. 4–9), J. S. Houser points out that insect pests are less

injurious to shade trees in the Middle West than in the east. Pests that are destructive in both areas are *Hemerocampa leucostigma*, S. & A., *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.) (elm leaf beetle), *Hyphantria textor*, Harr., *Palaeacrita vernata*, Peck, *Alsophila pometaria*, Harr., *Rhyacionia buoliana*, Schiff. (European pine shoot moth), and *Paratetranychus ununguis*, Jac. (conifer red spider).

In the Gypsy Moth Situation in Pennsylvania, by A. F. Burgess (pp. 26–30), details are given of work carried out against the gipsy moth [*Porthetria dispar*, L.] since the discovery of a new infestation in 1932 [**21** 258].

In Experiments in the Control of boring Insects, by C. C. Hamilton (pp. 31–36), previous work on the use of pine tar oils containing paradichlorobenzene against borers in trees is briefly reviewed [*R.A.E.*, A **16** 134]. Preliminary tests in 1932 showed that various mixtures of pine oils, resins, nicotine, alcohols and paraffin penetrated the burrows of larvae of bark-boring beetles and destroyed them, without in most cases injuring the trees. Further tests were carried out in 1933 with 20 mixtures of various fractions of pine oils and vegetable oils to which was added 5 per cent. nicotine and 5 per cent. paraffin to increase the toxicity, retard evaporation and give the treated surface a repellent effect. When applied (usually with a paint brush) in April or September to the trunks of sugar maples (*Acer saccharum*) infested with *Xylotrechus aceris*, Fisher, the mixtures killed the larvae, but some of them injured the trees even when only the infested parts were treated. One formula that was placed on the market proved satisfactory against borers and in most cases caused no injury. Some flowering dogwood [*Cornus florida*] that was treated in July, however, was killed, probably because the bark was too thin. These and other tests indicated that this material should not be applied to trees that are susceptible to injury by oil sprays, but it appears to be safe on trees with a heavy or corky bark.

E. P. Felt contributes a paper on Fundamentals in the Control of Insect Pests (pp. 37–43).

Eleventh National Shade Tree Conference Proceedings.—xii+167 pp., 3 figs. Philadelphia, Pa, 1935.

This series of papers includes three dealing with insect pests. In Non-poisonous Substitutes for Arsenicals (pp. 83–89), C. C. Hamilton discusses the advantages and disadvantages of lead arsenate as an insecticide, and gives an account, chiefly from the literature, of the properties, relative merits, and use of nicotine, pyrethrum and derris as substitutes for it. Sprays of derris powder in water have been used successfully against cankerworms and elm leaf beetles [*Galerucella luteola*, Müll.], but are not so effective or economical as lead arsenate. Against cankerworms the spray should be applied before the larvae are more than half grown, at a dilution of 1 lb. dust containing 1 per cent. rotenone to not more than 15 U.S. gals. water.

In The European Pine Shoot Moth (pp. 90–96), R. B. Friend and H. W. Hicock describe briefly the distribution of *Rhyacionia buoliana*, Schiff., in North America [*cf. R.A.E.*, A **23** 759], and its bionomics in Connecticut [**21** 566, etc.]. Pines 10–15 ft. high and those growing in the open appear to be most heavily attacked. Infestation continues longer on ornamental trees than on forest trees, and red pine [*Pinus resinosa*] may be infested for 12 years. In the case of this pine and

Scots pine [*P. sylvestris*] the ornamental value of the tree is destroyed and growth in height is retarded or stopped. The effect on mugho pine [*P. mugo*] is not so serious. The most common larval parasites are *Hyssopus thymus*, Gir., which is gregarious, and *Ephialtes* (*Calliephialtes*) *comstocki*, Cress., which is solitary [*cf.* **21** 567]. A spray of 1½ lb. lead arsenate and 1 U.S. pint fish oil in 50 U.S. gals. water applied to infested red pine on 22nd June and 2nd July 1935 gave 86 per cent. control [*cf.* **22** 394]. Sprays of lead arsenate with other spreaders or of ground derris with powdered skim milk were not quite so effective. The trees were 20–25 ft. high, and each required about 5 U.S. gals. of spray.

C. W. Collins, in Insect Vectors of the Dutch Elm Disease caused by the Fungus *Ceratostomella ulmi* (Schwarz) Buisman (pp. 127–132), gives a preliminary account of investigations begun in August 1933 in New Jersey on the known and possible insect vectors. According to observations by Wadley the total life-cycle of *Scolytus multistriatus*, Marsh., varied from 45 to 60 days in summer. The incubation period required about 5 days and the larval stage 25–30. As many as 50 per cent. of the overwintering larvae died in New Jersey in 1933–34. There appear to be two complete and a partial third generation in northern New Jersey. *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., is found in the north-eastern, eastern and north-central parts of the United States wherever elms are present. It deposits eggs in galleries in the inner bark and outer sapwood of the trees. It has two generations a year and appears to overwinter in the larval and adult stages, as both were found in southern New York on 24th April 1935. In laboratory and field experiments, 63 cases of the successful transmission of *C. ulmi* by *S. multistriatus* were recorded between January and June 1935. In 24 cases the fungus was isolated from egg galleries of *H. rufipes* in healthy logs. It has also been cultured from adults of both these Scolytids collected in plots from which diseased trees had been removed.

Studies are also being carried out on *Eutetrapha* (*Saperda*) *tridentata*, Ol., *Ceresa bubalus*, F., *Magdalis armicollis*, Say, and *M. barbita*, Say. *C. bubalus*, which is present in the infected area round New York, feeds on lucerne, etc., but lays its eggs in slits in the bark of elm and fruit-trees. *Ceratostomella ulmi* has been cultured from adults of *E. tridentata* and nymphs of *C. bubalus* that had been fed on diseased trees. The periodical cicada [*Tibicen septemdecim*, L.] also lays its eggs in the bark and may be found to transmit the disease. According to Jones and Hoffmann, *M. armicollis* and *M. barbita* puncture the bark of the trunks and branches of elms 2–5 ins. in diameter, but attack particularly small suppressed trees with one or more dead branches in the crown. *C. ulmi* was cultured from one of these weevils collected from a diseased tree in the field.

McDaniel (E. I.). **A new Significance concerning Insects attacking Elm.**—*Quart. Bull. Mich. agric. Exp. Sta.* **17** no. 3 pp. 142–144, 4 figs. East Lansing, Mich., February 1935. [Recd. December 1935.]

The relation of *Scolytus multistriatus*, Marsh., to Dutch elm disease [caused by *Ceratostomella ulmi*] in the United States [*cf. R.A.E.*, A **22** 652, etc.] is briefly discussed. This Scolytid has been found in certain parts of Massachusetts, New York, Connecticut, Pennsylvania, and New

Jersey, including many places free from the disease. It has not been observed in others in which the disease has occurred. The brood chambers made by this species are about 1½ ins. long and follow the grain of the wood, extending vertically from the entrance. The larval tunnels are at right angles to these.

Hylastes (*Hylurgopinus*) *rufipes*, Eichh., which is another possible vector of the disease [*cf.* **23** 132, etc.], confines its attacks to weak trees. Prolonged drought has so weakened elm trees in Michigan that this Scolytid is becoming very abundant. During 1934, it killed many trees that might otherwise have survived. The brood chambers are horizontal, and the larval tunnels follow the grain of the wood. One female lays from 20 to 75 eggs along each side of the brood chamber.

Valuable trees should be encouraged to resist the attacks of bark-beetles by giving them water and fertilisers. Badly infested trees should be destroyed.

HUTSON (R.). **Habits and Control of Chinch Bugs.**—*Quart. Bull. Mich. agric. Exp. Sta.* **17** no. 3 pp. 147–149, 2 figs. East Lansing, Mich., February 1935. [Recd. December 1935.]

Although chinch bugs [*Blissus leucopterus*, Say] are always present in Michigan, they only become a serious pest in years of drought. They damage grasses and cereals, particularly maize and barley. There are two generations a year. The adults overwinter under grass, leaves, etc., and fly to barley and other small grains in early spring when the temperature rises to 70°F. Thin stands of grain are infested first. Pairing takes place in late May and early June, and the females deposit about 200 eggs on the plants at or below ground level. The nymphs hatch in about 10 days. After harvest they migrate over the ground to maize or other available food-plants ; this migration takes place during the hottest part of the afternoon.

The construction of creosote barriers to trap the migrating insects is described [*R.A.E.*, A **14** 166, etc.]. The post-holes should be 20 ins. deep and 5½ yards apart. The creosote oil should be renewed every day for 3–5 days, and then about every other day, the barrier being maintained for 10–21 days. About 50 U.S. gals. creosote oil are required to maintain a barrier 440 yards long for 3 weeks. The bugs that accumulate in the post-holes are killed by pouring kerosene over them. Coal and gas tar are only a little less effective than creosote oil, but lubricating oil, used crankcase oil, and road oils are worthless.

SHERMAN III (F.). **Preparation and Use of chemically treated Codling Moth Bands.**—*Quart. Bull. Mich. agric. Exp. Sta.* **17** no. 3 pp. 150–152, 2 figs. East Lansing, Mich., February 1935. [Recd. December 1935.]

This is a brief account of the preparation, use and cost of corrugated paper bands treated with 1 lb. beta naphthol and 1½ U.S. pints lubricating oil [*cf. R.A.E.*, A **23** 311] to destroy larvae of the codling moth [*Cydia pomonella*, L.] in Michigan. The addition of 4–6 oz. crude paraffin will improve the bands during rainy or very hot weather. These amounts are sufficient for 50 ft. of 4-inch band. On small trees and when the infestation is light, 2-inch bands may be used. The bands should preferably be dipped shortly before being used, but do not lose their efficiency if stored in a tight container from one season to the

next. Young apple trees are sometimes injured by chemically treated bands, but in Michigan no injury to trees over 10 years old has been reported.

Thompson (B. G.). **Cutworm Control in Oregon.**—*Circ. Ore. agric. Exp. Sta.* no. 111, 6 pp., 4 figs. Corvallis, Ore., March 1935. [Recd. December 1935.]

This paper is a revision of a previous one [*R.A.E.*, A **15** 134], with the addition of notes on *Prodenia praefica*, Grote (yellow-striped army worm), which has recently caused considerable damage to potatoes, lucerne and garden crops in south Oregon. It differs from most cutworms in that it feeds during the day and rests on the plants at night, leaving them only when they are destroyed or dry up, so that it is not easily controlled by poison baits. Crops can be sprayed with 3 lb. calcium arsenate in 100 U.S. gals. water or dusted with a mixture of equal parts of 70 per cent. tricalcium arsenate and hydrated lime. Care should be taken that a poisonous residue is not left on the edible parts of vegetables, and the treatment of asparagus and leafy vegetables is not recommended. As most of the larvae hatch in uncultivated land and later migrate to gardens, the latter can be protected by ploughing a deep furrow round them with the steep side next to the crop. Holes 2–3 ft. deep are dug every 20–30 ft. in the bottom of the furrow, and any larvae that collect there can be killed by pouring oil over them.

Davis (A. C.) & Claborn (H. V.). **Cyanide Fumigation of Mushroom Houses.**—*Circ. U.S. Dept. Agric.* no. 364, 9 pp. Washington D.C., November 1935.

Comparative tests were made on the fumigation of commercial mushroom houses in the United States, under the conditions occurring at peak heat [*cf. R.A.E.*, A **20** 301 ; **22** 417], with chemically equivalent quantities of calcium cyanide, sodium cyanide with sulphuric acid (1–1½–2), and liquid hydrocyanic acid. The rates used were 1 lb., ½ lb. and ¼ lb., respectively, per 1,000 cu. ft. space, and the gas was distributed by fans placed 5–8 ft. from the floor with the current directed downwards. The greatest concentration occurred low down where it was most useful. All concentrations are given in mg. per litre [oz. per 1,000 cu. ft.]. The maximum and mean concentrations were respectively 2·81 and 1·2 for sodium cyanide, 2·93 and 1·28 for liquid hydrocyanic acid and 0·89–1·15 and 0·65–0·80 for calcium cyanide. The mean concentration was calculated only till the concentration of gas dropped to 0·4.

Tests were made of the lethal concentrations for *Lepidocyrtus lanuginosus*, Gmel., adults and larvae of *Xenylla* sp., and all stages of *Sciara* sp., *Tyroglyphus lintneri*, Osb., and *Histiostoma* sp. The temperature was brought from 75–80°F. to 100°F. in 6–8 hours, and the pests were kept at 100°F. and 90 per cent. relative humidity for 7–9 hours. The chamber was then fumigated with gas from sodium cyanide and acid. All insects and mites were killed by a concentration that reached a maximum of 3·6 with a mean of 1·67 and took 44 minutes to drop to 0·4. Slightly less than 100 per cent. kill was given by a maximum concentration of 2·9, a mean concentration of 1·56 and a drop to 0·4 in 38·5 minutes. While the springtails and all stages of

Sciara were killed by a mean concentration of 0·81 with an exposure of 40 minutes, the mites withstood a mean of 1·73 remaining above 1·3 for 90 minutes. Fumigations in which two successive doses were given were less effective than those in which the same quantity was given in one dose. The latter method gave a higher maximum concentration, but a shorter exposure. The concentrations secured in the houses with calcium cyanide are too low to give a complete kill. The cost of fumigation with sodium cyanide is about half that with either of the other two materials. Owing to the leakage in an average mushroom house, it is recommended that in practice 10 oz. sodium cyanide or 5 oz. liquid hydrocyanic acid should be used per 1,000 cu. ft.

Reinhard (H. J.). **North American two-winged Flies of the Genus** *Doryphorophaga*, **(Tachinidae, Diptera).**—*J. N.Y. ent. Soc.* **43** no. 4 pp. 387–394. New York, N.Y., December 1935.

A synopsis is given of the species of the Tachinid genus *Doryphorophaga*, with a key. The two previously described species, *D. doryphorae*, Riley, and *D.* (*Adoryphorophaga*) *aberrans*, Tns., are parasites of *Leptinotarsa decemlineata*, Say, in the United States. Four new species are described from the same country, of which *D. australis*, sp. n., was reared from *L. decemlineata* and *L. defecta*, Stål, in Texas.

Hawley (I. M.) & White (G. F.). **Preliminary Studies on the Diseases of Larvae of the Japanese Beetle** (*Popillia japonica* **Newm.).**—*J. N.Y. ent. Soc.* **43** no. 4 pp. 405–412. New York, N.Y., December 1935.

As many as 50 per cent. of the larvae of *Popillia japonica*, Newm., used in experimental work in the United States are killed by diseases. Previous work on these is reviewed. For the purpose of this paper, diseased and dead larvae taken in the field were classified into black, white and fungous groups, according to their appearance.

Most of the dead larvae found belonged to the black group but the cause of the disease or diseases in this group is not known. When healthy larvae were inoculated with suspensions of the diseased larvae in water, very few more died than in the control. When healthy larvae were placed in separate boxes, each with a diseased one, 40 per cent. died in 3 weeks, compared with 4 and 8 per cent. in untreated controls. Pure cultures of three species of bacteria from the decaying remains of dead larvae were injected into healthy larvae. Of the 10 larvae in each of the three series, 5, 7 and 8 were dead after 2 weeks whereas those punctured with a sterile needle were alive. Diseased larvae in different series showed different symptoms, and it is probable that more than one disease is involved.

The tissues of the affected larvae of the white group are filled with a micro-organism, in pure or nearly pure culture, but attempts to grow it on various media have been unsuccessful. Probably only one disease is present. In the fungous group, both live and dead larvae were found with mycelia penetrating the integument and invading the tissues. Probably more than one disease is present, but infectiousness has not been determined.

In tests in New Jersey to ascertain the reason for such a high mortality of the larvae used in experiments, samples of soil were taken from

a greenhouse bed where they had shown high mortality, from a plot where larvae had failed to develop, from a field beyond the present range of the beetle, and two from a local field, one of which was untreated and the second sterilised by heat. In each test 25 sterilised tins divided into 4 compartments by wire-screen partitions were filled with the soil, a healthy larva placed in each compartment and wheat added for food. The respective percentages that died after 44 days were 65, 14, 15, 16 and 15. In the sample of soil from the greenhouse some of the larvae showed fungous growth and others turned brown and disintegrated rapidly.

During 1933 and 1934 larval surveys were made weekly in grass sod in 8 localities in the older infested area in New Jersey and Pennsylvania. Although the percentage of diseased larvae varied greatly from month to month in some localities, it was relatively small in July (0·4 in 1933 and 0·1 in 1934) when the old brood is scarce in the soil and the new brood consists mainly of eggs and newly hatched larvae. There is a gradual increase during the summer, autumn and spring, and the peak is reached in May–June when the larvae are mature. In June 1933, 10 per cent. of the larvae found were diseased, and in one locality 29 per cent. were dead or dying. There were more diseased larvae in 1933 than in 1934. The reduction in the larval population between the autumn of 1933 and beginning of June 1934 was only 17 per cent., whereas the average reduction during the last 7 years has been 34 per cent. It seems that the diseases of the larvae may be largely responsible for the yearly fluctuations in population. Larval surveys show that disease is now present in most of the area infested by the beetle. Data from 27 localities in New Jersey and Pennsylvania in the spring of 1934, when from 0 to 12 per cent. of the larvae found were diseased, showed no consistent relationship between the extent of disease and the age of an infestation or density of larval population.

Hallock (H. C.). **Movements of Larvae of the Oriental Beetle through Soil.**—*J. N.Y. ent. Soc.* **43** no. 4 pp. 413–425, 5 figs., 2 refs. New York, N.Y., December 1935.

These laboratory and field studies on *Anomala orientalis*, Waterh., were carried out in New York from 1927 to 1933 inclusive. In preliminary experiments one third-instar larva was placed in soil in each of 10 glass-sided cages kept in the dark at a temperature of about 70°F. and its position recorded 3 times a day. After 3 months the average and maximum distances moved by the larvae were respectively 32·9 and 47 ft. in fallow soil and 13·9 and 19·4 ft. in soil containing growing wheat. The development of larvae in the fallow soil was retarded and 2 failed to mature.

Data on the vertical movement of larvae were obtained from weekly records of the number of larvae found at each inch in depth over a total area of 10 sq. ft. The total number recorded varied from 3,000 to nearly 8,000 per season. The data obtained are represented graphically. The most noticeable movement is a seasonal downward one about October and November and an upward one in April. The larvae overwinter at depths of 8–17 ins. In January 1932, when there were three weeks of warm weather and the mean soil temperature was about 43°F. at the 3-inch level, the larvae moved up to 4–6 ins. below the surface. Even during the hotter part of the year a few occur at

7–12 ins., but the percentage of larvae decreases with increase in depth. The females oviposit at depths of 1–11 ins., mainly 2–6 ins. In 1932, 42 per cent. of 1,590 eggs were found below 4 ins. The young larvae, on hatching, migrate upwards to near the surface, but usually move temporarily deeper before changing from one instar to the next and most noticeably just before pupation. Of 504 prepupae and pupae 77 per cent. were found at a depth of 4–7 ins. From 5 to 15 per cent. of the larvae fail to complete development the first year, but remain at 8–14 ins. and pupate in June of the following year. Of 742 larvae found in cultivated land, 31 per cent. were at 1 in., 44 at 2–4 ins., and 25 at 5–10 ins., whereas in mulched soil 65 per cent. were at 1 in., and 32 at 2–4 ins. The moist conditions near the surface apparently caused larvae to move upward. Attempts to control larvae by soil fumigation have probably been unsuccessful because the larvae at lower depths escaped. Lead arsenate, however, remains in the soil and destroys the larvae that return to feed in the surface layer.

Further tests in small cages, details of which are given, indicated that the larvae move further horizontally in fallow soil than in soil containing wheat. In large field cages, the maximum distance covered by the larvae was about 4 ft. (between September and June). In these latter tests there was little difference in movement in fallow soil and that containing wheat, probably because the former contained sufficient food in the form of organic material.

From 1930 to 1932 infestation by *A. orientalis* in a strawberry bed increased in intensity until at least 80 per cent. of the plants had died. The larvae then migrated to an adjoining raspberry bed. In each case the infestation spread outwards from the plants first infested. As many as 50 larvae were found around the roots of one bush. In lawns larvae tend to be more numerous in living grass at the edge of killed sods than in areas where the grass has died, but the extent of the migration varies with the amount of organic matter available for food. To control these larvae, insecticides [*cf. R.A.E.*, A **21** 456] should be applied over a large area round the dead plants.

King (K. M.) & Vigor (S. H.). **The Grasshopper Outbreak in Saskatchewan.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 5–21, 6 figs. Toronto, 1935.

An account is given of the grasshopper campaign in Saskatchewan in 1934. Following the outbreak in 1933 [*cf. R.A.E.*, A **23** 538], egg surveys [*cf.* **23** 311] showed that 23 out of 32 million acres of cultivated land were threatened in 1934. An intensive campaign was organised, the important feature of which (in view of economic conditions) was summer-fallowing stubble land. A marginal portion of the field was kept free from vegetation to check the migration of hoppers. The remainder of the field was then cleared in strips, concentrating the young hoppers at the central unweeded portion, where they were poisoned easily and economically. Narrow fallow barriers were advised round the seeded fields to check invasion temporarily. Where it was intended to sow stubble lands, deep ploughing was advised to destroy the eggs. It was estimated that 44 million bushels of wheat were harvested from the infested area, of which over 10 million had been saved by the campaign ; grasshoppers probably destroyed about 6 million bushels.

Seaman (H. L.). **The Influence of Cultural Practices on Field Crop Insects.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 22–28. Toronto, 1935

Dustan (A. G.). **The Influence of Cultural Practices on Garden and Vegetable Insects.**—*Op. cit.* pp. 28–36, 46 refs.

Gorham (R. P.). **The Influence of Cultural Practices on Garden, Field and Vegetable Crop Insects.**—*Op. cit.* pp. 36–40.

Caesar (L.), Hall (J. A.) & Kelsall (A.). **The Influence of Cultural Practices on Orchard Insects.**—*Op. cit.* pp. 40–42.

Bucknell (E. R.). **The Influence of Cultural Practices on Tree Fruit Insects in British Columbia.**—*Op. cit.* pp. 42–43.

Balch (R. E.). **Cultural Practices and Forest Insects.**—*Op. cit.* pp. 43–49, 17 refs.

In the first of these papers, the term "cultural practice" is defined as comprising all activities that are combined to produce a crop. In the case of field crops, these activities are grouped under the three main heads of soil preparation, seeding and harvesting, and the effect on the insects of each operation is distinguished. Discrimination in summer-fallowing and in the use of the plough is necessary in connection with various pests. Deep ploughing destroys the eggs of grasshoppers, but favours the survival of the eggs of the pale western cutworm [*Porosagrotis orthogonia*, Morr.]. Variation in the date of sowing crops and the use of trap crops also help control.

In the second paper lists are given of the insects (chiefly vegetable pests) affected by each operation of the practices described.

Amongst the measures advocated in the third paper, which deals with insects in New Brunswick, is that of double thinning swedes with the interval of a week. Complete freedom from the root maggot [*Phorbia brassicae*, Bch.] was obtained by this method, while 75 per cent. of the plants in the control plot (singly thinned) died from the attack. The first bloom of red clover should be cut early to destroy the larvae of the seed midge, *Dasyneura leguminicola*, Lint. In June and early July 1932, 21·43 per cent. of the first bloom heads were infested, and consequently 44·75 per cent. of the second bloom heads were attacked and only 14·5 per cent. of the florets developed any seed. Intercropping is suggested for the protection of some plants. Tomatos grown alternately with potato plants were little infested with the flea-beetle, *Epitrix cucumeris*, Harr., as the potatoes were more attractive.

Subjects discussed in the fourth paper include the variety of fruit tree, distance of planting, pruning, windbreaks, clean cultivation, fertilisers, scraping and banding trees and the destruction of insects in packing houses.

The fifth paper very briefly suggests possibilities of the control of pests that spread to tree fruits from cover crops by careful management of the latter.

The sixth paper deals with the cultural practices suitable for forest areas. Site, density, shade, seed selection and cutting methods are among the factors discussed. Mixed forests are less susceptible to attack by insects than pure ones.

Friend (R. B.). **The European Pine Shoot Moth in Connecticut.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 50–54, 10 refs. Toronto, 1935.

The course of the infestation of pines by *Rhyacionia buoliana*, Schiff., in Connecticut and measures taken for its control [*cf. R.A.E.*,

A **21** 566 ; **22** 394 ; **23** 553, etc.] are reviewed. Trees on both good and bad soil are attacked, but those more than 20 ft. high are not seriously injured. The infestation spreads mainly through the transportation of one of the insect's preferred food-plants, mugho pine [*Pinus mugo*], which is used as an ornamental tree. Control measures applied in 1933–34 reduced the numbers of *R. buoliana* considerably.

PALM (C. E.). **Notes on the Alfalfa Snout Beetle,** *Brachyrhinus ligustici* **L., a new Insect Pest in New York State.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 54–58, 1 fig., 4 refs. Toronto, 1935.

Most of the information given in this account of *Otiorrhynchus* (*Brachyrrhinus*) *ligustici*, L., on lucerne in New York State has been noticed from previous reports [*R.A.E.*, A **23** 465, 557]. When caged separately, 40 females laid 13,427 eggs, 125–515 per weevil. The pupal period lasted 22 26 days. The larvae sometimes bored into the heart of the older roots, leaving the shell of the cortex. In addition to the food-plants already noticed [**23** 557], the larvae have been observed on several others, but it is not known whether they can complete development on them.

GRAY (H. E.). **Some Stored Product Pests in Canada with Special Reference to the Hairy Spider Beetle,** *Ptinus villiger* **Reit.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 59–68. Toronto, 1935.

An account is given of the infestation of flour by *Ptinus villiger*, Reitt. (hairy spider beetle) in country warehouses in western Canada [*R.A.E.*, A **23** 542]. Other insects taken in flour mills and warehouses in various parts of Canada [*cf.* **23** 332] include *Niptus hololeucus*, Fald., *Attagenus piceus*, Ol., and *Tenebroides mauritanicus*, L., *Tenebrio molitor*, L., and *T. obscurus*, F., which are easily controlled by cleaning, *Dermestes lardarius*, L., which is found in prepared food containing a percentage of animal matter, *Alphitobius laevigatus*, F. (*piceus*, Ol.) in bran shorts and middlings, *Oryzaephilus* (*Silvanus*) *surinamensis*, L., in grain, and the meal moths, *Plodia interpunctella*, Hb., *Pyralis farinalis*, L., and *Tinea granella*, L.

VAN STEENBURGH (W. E.). **Parasites of the Oriental Fruit Moth** (*Laspeyresia molesta* **Busck) in Ontario. A Summary 1932–33–34.** *Rep. ent. Soc. Ont. 1934* **65** pp. 68–72. Toronto, 1935.

From 1932 to 1934, a decline occurred in infestation by *Cydia* (*Laspeyresia*) *molesta*, Busck, in peach orchards in Ontario. Parasitism by *Trichogramma minutum*, Riley [*cf. R.A.E.*, A **22** 361] also declined, being seldom greater than 20 per cent., and in most orchards 10 per cent. or less. In low infestations of the host the numbers of *Trichogramma* released made little difference to control. Releases were therefore discontinued in 1933.

A list is given of 39 parasites attacking *C. molesta* in Ontario. Only two of these are important, the introduced *Macrocentrus ancylivorus*, Rohw. [*cf.* **21** 284] and the native *Glypta rufiscutellaris*, Cress. *Macrocentrus* attacks both generations of the host. In the east of the Niagara peninsula this parasite was successful, but in the west where smaller individual releases were made on the second generation, parasitism was not high. *Glypta* attacks chiefly the second generation

larvae, and its late appearance allows *C. molesta* to produce a large population, so that in spite of a high parasitism of the second generation severe infestations may occur. In 1934 *Macrocentrus* and *Glypta* parasitised 12·3 and 0·4 per cent. of the first generation and 38·6 and 39·4 per cent. of the second generation respectively, while other parasites attacked 3·47 and 7·6 per cent. When *Macrocentrus* becomes more numerous, *Glypta* is less successful. The former is more important in the east of the Niagara peninsula, and the latter in the west.

Baird (A. B.). **Biological Control of Greenhouse Insects.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 72–73. Toronto, 1935.

The use of *Encarsia formosa*, Gah., against *Trialeurodes vaporariorum*, Westw., has been steadily increasing in Canada, since its introduction in 1928 [*cf. R.A.E.*, A **17** 253]. Complete control has been obtained except in cases where the whitefly had reached destructive numbers before the liberation of the parasite. Since the parasite population is reduced by the destruction or removal of plants between seasons, it is necessary to restock the houses for every crop. This is probably cheaper than a single fumigation.

A Braconid, *Aphidius phorodontis*, Ashm., was reared from Aphids on dock [*Rumex*] in the autumn of 1932, and gave good control of Aphids in warm greenhouses during the winter of 1933–34, so that no spray was necessary. In the colder houses the parasites did not develop during the winter, but increased rapidly in March and April while the growth of food-plants of the host was rapid, so that no sprays were necessary in the spring.

Kelsall (A.). **The Iron Sulphate and Lime-sulphur Mixture.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 73–76. Toronto, 1935.

A mixture of crystalline ferrous sulphate and standard lime-sulphur [*cf. R.A.E.*, A **19** 473] is now more widely used on apples in the Maritime Provinces of Canada than any orchard spray except Bordeaux mixture. Many insecticides are effective when used in conjunction with the mixture. Nicotine sulphate has no effect on the fungicidal value of the spray, lead arsenate increases it slightly, and calcium arsenate materially. The most satisfactory formula has proved to be 10 lb. ferrous sulphate, 2½ gals. lime-sulphur and 4–5 lb. calcium arsenate per 100 gals. water, although in the case of well-sprayed orchards 6 lb. ferrous sulphate, 1½ gals. lime-sulphur and 3–4 lb. calcium arsenate is likely to be sufficient. Experiments showed that lime-sulphur injury is reduced, as the content of ferrous sulphate is increased to 4 lb. per gal. concentrated lime-sulphur. Nearly all the lime-sulphur is then precipitated. If a higher proportion of ferrous sulphate is used, the excess causes injuries to the trees. An increase in the amount of ferrous sulphate permits an increase in the amount of arsenical with safety to the foliage [*cf.* **23** 629].

Extensive tests proved that while Bordeaux mixture, a mixture of ferrous sulphate, lime-sulphur and calcium arsenate, and a mixture of lime-sulphur with lead arsenate are effective as fungicides in that order, the difference between them is small and they may be considered equally efficient. Calcium arsenate with ferrous sulphate and lime-sulphur gave rapid control of ordinary leaf-eating caterpillars on apple, but it was not so effective as lead arsenate and lime-sulphur against bud-moths and leaf-rollers. On experimental areas treated with these

spray mixtures over a long period, the population of the European red mite [*Paratetranychus pilosus*, C. & F.] was consistently greatest on apples sprayed with Bordeaux mixture, intermediate on those sprayed with ferrous sulphate and lime-sulphur mixture, and lowest on those sprayed with lime-sulphur only. The ferrous sulphate and lime-sulphur mixture had a less injurious effect on foliage than Bordeaux mixture or lime-sulphur and lead arsenate, but if it was applied too late in the season, the fruit was discoloured. It could also be used in conditions of moisture impracticable for the other two. The most satisfactory spreader tested was lignin pitch (3–4 lb. per 100 gals.) but it is possibly not economically justified.

Kelsall (A.). **An improved Form of Arsenious Oxide as an Insecticide.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 76–78. Toronto, 1935.

Brief notes are given on the properties of a form of arsenious oxide that differs from the commercial white arsenic and is probably more valuable as an insecticide. It contains 70 per cent. metallic arsenic compared with 22 and 46 per cent. in lead and calcium arsenates respectively, but is more toxic to insects than these figures indicate. Tests on various insects in the insectary and in the field have shown that about 1 lb. is equivalent to 4–6 lb. lead or calcium arsenate. Unlike white arsenic it has good adhesive properties, is readily wetted with water and remains for some time in suspension. When combined with Bordeaux mixture or with an iron sulphate and lime-sulphur mixture so that not more than 1 lb. is present with 6 lb. copper or iron sulphate, it does not harm the trees ; but alone or with lime-sulphur it is injurious. It increases the fungicidal value of the iron sulphate and lime-sulphur mixture, as does calcium arsenate.

Patterson (N. A.). **Indices of Toxicity for various Poisons to *Drosophila ampelophila* Loew.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 78–80. Toronto, 1935.

The relative toxicities of 63 substances were determined by feeding *Drosophila melanogaster*, Mg. (*ampelophila*, Lw.) on baits containing them. This insect fed readily on all the baits tested, with the possible exception of those poisoned with derris and pyrethrum. Other flies were repelled by many of the poisons. The baits used were apple syrup and molasses, each diluted with water to a concentration of 12 per cent., and sugar-glycerine, diluted to 5 per cent. cane sugar and 2·5 per cent. glycerine. Poisons were compared at 6 concentrations, from 1 : 200 to 1 : 6,400, with each concentration half the previous one. The " Index of Toxicity " used for comparison is a figure based for each poison on the lengths of life of the flies while consuming the bait at each dilution of the poison.

The effect of the poisons varied considerably with the bait. Poisons with indices of toxicity greater than 90 were : in all 3 baits, 3 : 5 dinitro-orthocresol ; and in sugar-glycerine only, mercuric iodide (the commercial product), dinitro-orthophenylphenate, dinitro-orthophenylphenol and its nicotine compound, and sodium dinitro-orthocyclohexylphenate. More common substances with indices over 50 include : with apple syrup, calcium, manganese and sodium arsenates, sodium arsenite, fluoride and fluosilicate, arsenious oxide, and mercury bichloride ; with molasses, calcium, manganese and sodium

arsenates and sodium arsenite ; with cane sugar and glycerine, sodium arsenate, arsenite, fluoride and fluosilicate and arsenious oxide. Among the poisons with very low toxic indices were basic lead arsenate and arsenic sulphide.

CAESAR (L.). **The Turnip Aphid Outbreak in Ontario.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 84–85. Toronto, 1935.

In 1934 a severe outbreak of *Aphis* (*Rhopalosiphum*) *pseudobrassicae*, Davis [*cf. R.A.E.*, A **15** 666] caused much damage in south-eastern Ontario to swedes and white turnips, and less to rape. The outbreak began in late July, reached its maximum about 10th August, and was declining a week later. Cabbages and cauliflowers were not infested even when growing next to the turnips. In each district the attack was very localised, in some cases 25 per cent. of the fields were little damaged while the rest were severely injured. Rapidly growing crops were often heavily attacked, probably because of their great succulence. The outbreak was probably connected with the period of dry weather in June and July.

Parasites and predators were numerous in some fields, and late in the season up to 20 per cent. of the Aphids were killed by a fungus, but the infestation was probably ended by a change in the conditions of the food-plant and the weather. Of insecticides tested in the laboratory and the field, the best was a spray of 1 lb. linseed-oil soap in 10 gals. water, applied from beneath the leaves so as to wet all the Aphids.

CAESAR (L.). **The Corn Borer Situation in Ontario in 1934.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 85–87. Toronto, 1935.

As compared with 1933 [*cf. R.A.E.*, A **23** 231], infestation of maize by the corn borer [*Pyrausta nubilalis*, Hb.] decreased during 1934 in all counties but one. This county was among the 4 in which the Corn Borer Act was not enforced. The reduction as a whole was probably due to drought as well as control measures. Low winter temperatures did not cause a mortality large enough to reduce the population to this extent.

MITCHENER (A. V.). **The Grasshopper Campaign in Manitoba in 1934.** —*Rep. ent. Soc. Ont. 1934* **65** pp. 87–89, 1 map. Toronto, 1935.

In controlling the outbreak of grasshoppers in Manitoba during 1934, a bait was used similar to that distributed in 1933 [*R.A.E.*, A **23** 235]. It contained a larger proportion of sawdust, in some cases 2 parts sawdust to 1 part bran. No salt was used in it. Bait-mixing began on 16th May and finished by 12th July. During this time 13,767 tons of prepared wet bait were distributed to 18,500 farmers. It is estimated that about 7 million bushels of wheat, $4\frac{1}{2}$ million bushels of oats and 3 million bushels of barley were saved. The species of grasshoppers present were the same as in 1933, the most important being *Camnula pellucida*, Scudd. Oviposition on roadsides, headlands and other areas of short grass should be prevented by ploughing, and any beds of eggs found should be destroyed by ploughing deeply in the autumn or spring.

Gorham (R. P.) & Burnham (J. C.). **Aphids in New Brunswick Potato Fields in 1934.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 89–90. Toronto, 1935.

Samples of Aphids were taken from all types of potato fields in 13 counties of New Brunswick during 1934. From 792 identifications, *Macrosiphum solanifolii*, Ashm., was the most abundant in all districts. *Aphis rhamni*, Boy. (*abbreviata*, Patch) was also found in all districts but was most abundant in the west and scarce in the north and south. Some examples of *Myzus persicae*, Sulz., occurred in the west. The Aphids caused no economic damage.

McLaine (L. S.). **Precautions taken to Prevent the Importation of Pests and Diseases on Exhibits for the World's Grain Exhibition, Regina, 1933.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 90–93. Toronto, 1935.

As a result of precautions taken concerning the exhibits, no outbreak of insect pests occurred during or resulted from the World's Grain Exhibition held in Saskatchewan in 1933. Experiments carried out on a wide variety of grains showed that neither fumigation with carbon bisulphide nor with a mixture of ethylene dichloride and carbon tetrachloride affected their appearance or germination. In view of danger from fire, the mixture of ethylene dichloride and carbon tetrachloride was used at the rate of 14 lb. per 1,000 cu. ft. at 80°F. to fumigate exhibits. Some of the display exhibits were severely infested with *Calandra* (*Sitophilus*) *oryzae*, L., and *Sitotroga cerealella*, Ol. As a precaution against the European corn borer [*Pyrausta nubilalis*, Hb.], all maize on the cob was superheated.

Sheppard (R. W.). **Coleopterous Collections from Japanese Beetle Traps in southern Ontario.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 93–97. Toronto, 1935.

Following the receipt of information from the United States Department of Agriculture that *Popillia japonica*, Newm., had been taken near the border in 1932 and 1933 [*cf. R.A.E.*, A **22** 410; **23** 233], trapping [*cf.* **22** 633] to determine whether it had penetrated into Canada was undertaken in 1934 in several Provinces, but particularly in southern Ontario. Traps were placed in sunny exposed positions from late July until late September or early October, over a period of 10–12 weeks. No examples of *P. japonica* were taken, but a varied collection of other Coleoptera was obtained, and notes on those identified are given.

Arnott (D. A.). **Observations on the Flight of Adults of the Genus *Crambus* with Special Reference to the Economic Species.**—*Rep. ent. Soc. Ont. 1934* **65** pp. 98–107, 2 figs., 10 refs. Toronto, 1935.

This paper deals with the bionomics of various species of *Crambus* as studied at Chatham, Ontario [*cf. R.A.E.*, A **21** 285] from 1931 to 1934, chiefly by catches in a light-trap. The trap is described, and the exact times when it was in operation (approximately from April to October) are given. Two charts show in detail the flights of 11 species, as indicated by the records of the trap.

C. trisectus, Wlk., appears to be the most abundant species near Chatham. The larvae attack grasses, but are unnoticed unless the infestation is severe. There are two broods annually, the moths flying from mid-June to mid-July, and from mid-August to mid-September. The number taken in the trap was greatest in 1934, slightly smaller in 1931 and very much smaller in 1932 and 1933. In 1931 severe injury to grass was reported from south-western Ontario, but none in later years, even in 1934. In 1931 the second flight was smaller than the first, and in succeeding years the number of moths decreased ; some natural control was probably operating. In 1934 this may have ceased, since the second flight was larger than the first.

The species of the group including *C. luteolellus*, Clem., *C. caliginosellus*, Clem., and *C. zeellus*, Fern., the specific distinctness of which is uncertain, are economically the most important in this district, injuring tobacco, maize and other crops. In 1931 more injury was reported than in subsequent years, although a great flight took place in 1934. The moths are strongly attracted to light. There is only one distinct annual brood near Chatham, the moths being taken from early June to late August, and a few throughout September. The trap records indicate that the larvae are active until mid-June ; field observations show they are active on tobacco and maize during the first week in June, but the injury is less by 15th June and has ceased by the end of the month.

C. vulgivagellus, Clem., is common and strongly attracted to light. Field observations and trap records established that it has one generation a year at Chatham, flying from mid-August to the end of September. In 1931 the larvae injured pasture severely, but no damage has been reported since.

C. teterrellus, Zinck., which was uncommon in 1931, increased yearly up to 1934. Since it is strongly attracted to light, the numbers caught in the trap are large compared with those found in the field. There are at least two broods annually in this district, which fly in June and from late August to early October, but the moths that fly in late September and early October may represent a partial third brood. In late 1931, although few of this species were taken in the trap, the larvae injured turf severely 60 miles away.

Other species of less economic importance that were taken in large numbers included *C. hortuellus*, Hb., which flies from June to August and is strongly attracted to light, and *C. mutabilis*, Clem., which has two broods a year. Of the remaining species, 8 were present in moderate numbers and 3 were scarce.

GARLICK (W. G.). **Some Observations on the Grape Berry Moth.**— *Rep. ent. Soc. Ont. 1934* **65** pp. 108–112. Toronto, 1935.

An account is given of the bionomics of *Polychrosis viteana*, Clem., in Ontario, from observations made from 1929 to 1934. The larvae regularly cause slight, and occasionally severe, injury to grapes by feeding on the blossoms and fruit. They are also found on wild grapes, and in 1929 were observed in numbers on the flower clusters of elder (*Sambucus canadensis*). Possibly the moths do not fly far, since the infestations are often quite local. The ends of the rows of vines appear to be more heavily infested.

Emergence of moths from overwintered pupae started in late May or early June, and was at its peak from 16th–28th June, when wild

grapes had ceased to flower and cultivated ones were beginning. In 1934 the peak of emergence was later, and moths of the overwintering brood continued to emerge until early October. This was probably due to dry weather and soil conditions. Females represented 78 per cent. of 3,798 moths emerging in cages and 83·5 per cent. of 1,466 taken in bait pails. From limited observations, the average preoviposition period was 3–4 days. Moths lived 7–30 days in cages, and laid eggs for 4–15 days. Eggs were laid on the leaves, green stems and parts of the flower clusters, and preferentially on the fruit as soon as it was set. In the field, no eggs were laid on the leaves. The incubation period was 4–8 days. The early larvae fed on the blossoms, often boring into the side of a bud for protection. Later they tunnelled into the pulp of the grape, entering other contiguous grapes when the first were finished or before, and connecting the two together with webbing. The larval period was about 21 days. In the insectary in 1930, first generation larvae matured from 11th July to 20th August, and by the latter date some larvae of the second generation had also matured. The mature larvae cut the leaves of the food-plant to form cells in which they pupated. The prepupal and pupal periods together lasted 10–23 days. Larvae that mature after mid-August do not produce adults in the same year ; in 1930 about 77 per cent. of the first generation pupae gave rise to moths without hibernating. The first generation moths laid eggs on the fruit only. The second generation larvae matured from 18th August to the beginning of November in 1930. They made cells from leaves on the ground and passed the winter in the pupal stage.

Under artificial conditions winter mortality varied from 29 to 83 per cent. Pupae near the surface survived the severe winter of 1933–34, and also withstood temperatures of 0°F. The correlation of the presence of snow with low winter mortality is probably due to the moisture, since few moths emerge under dry conditions of soil and weather. The eggs of *Polychrosis* are parasitised by *Trichogramma*, particularly when they are numerous late in the season. The chief larval parasite in 1929 was *Angitia* (*Dioctes*) *obliterata*, Cress., the adults of which emerged from the leaf cells in which the larvae had spun up. In 1933 *Glypta* sp. near *varipes*, Cress., was reared from leaf cells containing overwintered pupae. Two examples of *Microbracon variabilis*, Prov., were also bred from *Polychrosis* material.

Twinn (C. R.). **A Summary of Insect Conditions in Canada in 1934.**— *Rep. ent. Soc. Ont. 1934* **65** pp. 112–128, 1 ref. Toronto, 1935.

An account is given of the occurrence in Canada in 1934 of many insect pests on field and garden crops and fruit, forest and shade trees, and in houses and stored products. Insects recorded for the first time in the localities concerned were : *Eurycephalomyia myopaeformis*, Roeder (*Tetanops aldrichi*, Hendel), on beet in Southern Alberta ; *Forda occidentalis*, Hart (wheat root aphis), also in Alberta ; *Cydia* (*Laspeyresia*) *nigricana*, Steph., on peas in British Columbia ; the Torymid, *Syntomaspis druparum*, Boh., which caused dwarfing and malformation of apples in Ontario ; *Corthylus punctatissimus*, Zimm., which killed many seedlings of sugar maple [*Acer saccharum*] in Quebec ; and the satin moth, *Stilpnotia salicis*, L., in Newfoundland. *Pemphigus betae*, Doane, though already known to occur in southern Alberta, caused serious injury to sugar-beet there for the first time.

Bouhelier (R.), de Francolini (J.) & Perret (J.). **Essais attractifs pour la destruction de** *Ceratitis capitata* **Wied.**—*Rev. Zool. agric.* **34** no. 10 pp. 149–152. Bordeaux, 1935.

Preliminary experiments were carried out at Marrakech, Casablanca and Rabat (Morocco) during 1934 on the relative attractiveness of baits for trapping *Ceratitis capitata*, Wied. Clensel solution [*cf. R.A.E.*, A **19** 647], a solution of molasses containing ammonium fluoride or bifluoride, and a bait prepared by steeping 11 lb. coarse flour (middlings) and 11 lb. borax in 20 gals. water for 24–48 hours and straining the water for use were tested in all three localities, and some additional baits were also used at Marrakech and Rabat.

At Casablanca and Rabat, the borax bait caught 33·6 and 12·2 per cent. of the total number of flies taken in each place, compared with 16·8 and 7·6 per cent. caught by the Clensel bait. In Marrakech, 6·5 per cent. were caught by the borax bait and 25·4 per cent. by the Clensel. It was observed in Casablanca and Rabat that Clensel caught fewer flies than borax in wet cold weather but more in hot dry weather, and the fact that the trials were made in these districts in November and December while the greatest captures in Marrakech were made in July and October accounts for the difference in the results. At Marrakech and Casablanca a solution of 10 per cent. sugar-cane molasses (50 per cent. sugar content) with 5 per cent. ammonium bifluoride caught 51·4 and 49·6 per cent. of the flies ; at Rabat a solution of 5 per cent. molasses and 2 per cent. ammonium fluoride caught 56·5 per cent. Solutions of sodium fluoride and ammonia with molasses gave approximately equal and negligible catches. Ammonium bifluoride in water caught no flies. The physical condition of the solution must therefore account for the attractiveness of the mixture of ammonium fluoride or bifluoride and molasses.

Bruneteau (J.). **Les pièges-appâts et les** *Cerambyx*.—*Rev. Zool. agric.* **34** no. 10 p. 163. Bordeaux, 1935.

The larvae of *Cerambyx scopolii*, Fussl., bore galleries in the wood beneath the bark of apple trees in France and sometimes kill them. They spend two years in the tree. The most effective control is cutting off the infested branch, but this is not possible where the main trunk is mined. It was found experimentally that many adults were caught at the beginning of June in trap pans baited with molasses and water.

de Francolini (J.). **Emploi de l'huile de soja comme insecticide.** *Rev. Zool. agric.* **34** no. 11 pp. 165–166, 3 refs. Bordeaux, 1935.

Experiments were carried out in Morocco on the use of cheap vegetable oils [*cf. R.A.E.*, A **19** 519 ; **21** 325] as sprays for the control of Aphids on fruit trees.

Soy-bean oil, of density 0·924 and acidic index (Kottstorfer's method) 0·78, was mixed with oleic acid and ammonia at the rate of 2½ gals. oil, ½ gal. oleic acid, 1 pt. ammonia and 3 pts. water. This formed a viscous paste that emulsified easily and kept well. When applied at a concentration of 1 per cent. to *Aphis rumicis*, L., it gave 95 per cent. control in less than 12 hours in several experiments. On a large scale it gave complete control of several species of Aphids on *Euonymus*, plum and orange trees, had good covering qualities, and did not injure

the foliage. Orange trees were treated in full bloom and were not damaged. The spray was inefficient against Coccids ; when used at a concentration of 2 per cent. against *Lepidosaphes beckii*, Newm. (*citricola*, Pack.) and *Chrysomphalus dyctiospermi*, Morg., it killed 32 and 63 per cent. respectively.

Olive oil of inferior quality contained sufficient free oleic acid to be emulsified with ammonia only, but a 2 per cent. concentration never killed more than 30 per cent. *A. rumicis*.

Balduf (W. V.). **The Bionomics of Entomophagous Coleoptera.**—Imp. 8vo, 220 pp., 108 figs., 17 pp. refs. St Louis J. S. Swift & Co., 1935.

This comprehensive monograph on the bionomics of Coleoptera that feed on other insects is divided into 14 sections dealing respectively with each of the 13 principal families and with those that are smaller or less important as predators. Each family is treated as a whole ; the typical life-history is given, followed by remarks on individual species, with references to the extensive bibliography. The food and feeding habits of the beetles are discussed in more detail than other aspects of their bionomics.

Troy (Z.). **Aster Yellows and its Control. A brief Summary of the Work of Dr. L. O. Kunkel in Solving an important Growers' Problem.**—*Flor. Exch.* **85** no. 16 pp. 13 & 17, 3 figs., 6 refs. ; also as *Prof. Pap. Boyce Thompson Inst.* **1** no. 28 pp. 262–266, 3 figs. Yonkers, N.Y., 1935.

This is a summary of the work of L. O. Kunkel on the transmission of aster yellows by *Cicadula sexnotata*, Fall., in the United States and its control, and most of the information has been noticed [*R.A.E.*, A **12** 162 ; **14** 164 ; **15** 284 ; **19** 580]. A female of *C. sexnotata* under observation lived 87 days and laid eggs from which 127 nymphs hatched in 11–13 days. They reached the adult stage about 20 days later. A list is given of 44 plants from which aster yellows is transmitted to asters by the insect. Many of these are biennials or perennials. Effective control is obtained by growing the asters under tents of cheesecloth (22 by 22 threads to the inch) or tobacco cloth [*cf.* **20** 420]. This disease is similar to, but distinct from, false blossom of cranberry, and is not the same as the stunt disease of dahlias. It produces a slight yellowing along the veins of the whole or a part of a young leaf, and later chlorosis. Infected plants give an abnormal number of secondary shoots, and the plants are stunted if not already full-grown.

Cook (W. C.). **Cutworms and Army Worms.**—*Circ. Minn. agric. Exp. Sta.* no. 48, 8 pp., 13 figs. St. Paul, Minn., September 1934. [Recd. December 1935.]

Cutworms and army-worms are serious pests of garden and field crops in Minnesota. A key to the larvae of 11 species is given.

The larvae of *Lycophotia margaritosa*, Haw. (variegated cutworm) hibernate when partly mature and resume activity in spring. In early spring they eat any available food, and in late May attack garden plants. They pupate about 1st June, and the moths emerge about 1st July. The female lays up to 2,000 eggs on the lower surface of the

leaves of clover, peas and beans. The first generation larvae feed during July and pupate about 1st August. In late July if abundant they move in armies and may do immense damage in a few days. The first generation moths lay eggs in September, from which the overwintering larvae are derived. The army-worm, *Cirphis unipuncta*, Haw., has a similar life-history, but lays up to 500 eggs on grass, preferably in low-lying meadows.

The larvae of *Euxoa tessellata*, Harr. (striped cutworm) emerge from hibernation near the surface of the ground in April and are destructive to vegetable crops at the end of May and the beginning of June. They pupate about mid-June, and the moths emerge in July and August. Young larvae have been found in September. *Euxoa messoria*, Harr. (dark-sided cutworm) and *Feltia ducens*, Wlk., are active earlier than *E. tessellata*. They pupate in early June but the pupal stages lasts longer, so that the eggs are laid at about the same time. *Agrotis unicolor*, Wlk. (W-marked cutworm) is a climbing species that sometimes destroys the buds of fruit trees. The larvae pupate in May, and the moths emerge after 15th June. They probably live till September before depositing small clusters of eggs on the underside of clods of soil. *Agrotis c-nigrum*, L. (spotted cutworm) may have two generations a year, but if so the second is not large. The larvae pupate before 1st June and moths are found by 1st July. *Agrotis ypsilon*, Hfn. (greasy cutworm) may also have two generations a year. Some larvae are found throughout the summer, and moths after 1st July. Onions are very attractive to *A. ypsilon* and *E. messoria*. The larvae of *Agrotis fennica*, Tausch. (black army-worm) pupate about 25th May, and the adults are found in late June. Baits for this species should contain more molasses than usual. All these cutworms may attack field crops, but, except *A. fennica*, they are primarily pests of garden crops.

The yellow-headed and glassy cutworms, *Parastichtis* (*Septis*) *arctica*, Boisd., and *Sidemia devastatrix*, Brace, are underground species that live almost entirely on field crops. They occur in sod land and when the sod is broken are forced to attack the cultivated plants. They are chiefly active between 15th May and 10th June when they pupate. The moths emerge in July and oviposit in grass-land. The larvae cut off the plants below the surface of the soil, and poison bait for them must be harrowed about an inch below the surface. All land to be used the next year for cereals should be kept free from grass and weeds, which attract the ovipositing females.

Methods of control recommended include clean cultivation to prevent hibernation, autumn ploughing to prevent late oviposition in the fields and to cover the young larvae and the eggs already laid, and the application of poisoned bait [*R.A.E.*, A **21** 67] in the afternoon or evening. Collars of stiff paper (not tarred paper) round the stems, 3–4 ins. high and about 1 in. below the surface, prevent the larvae from reaching the plants. When the larvae move in armies, they may be kept out of a field by ploughing round it a deep trench in which poisoned bait is placed.

NEWTON (J. H.). **Codling Moth Studies. North Fork Valley of Colorado.** —*Bull. Colo. agric. Exp. Sta.* no. 414, 47 pp., 5 figs., 6 refs. Fort Collins, Colo., April 1935. [Recd. December 1935.]

A detailed account is given of the experimental work on the life-history and control of *Cydia* (*Carpocapsa*) *pomonella*, L., carried out at

Paonia, Colorado, from 1918 to 1934 [*cf. R.A.E.*, A **21** 333 ; **23** 757]. In this locality, the moth normally has two generations a year, but only 40 per cent. of the first and 2 per cent. of the second brood larvae transform in the same year, the remainder overwintering.

Details of spray experiments in 1931–33 are given. The most satisfactory programmes were based on trapping records for each individual orchard, using fermented apple juice as bait. Four cover sprays of lead arsenate or cryolite (sodium fluoaluminate) gave approximately equal control, fish oil being used with the cryolite. Lead arsenate is recommended. Colloidal spreaders and neutral soaps [*cf.* **23** 757] did not increase the effectiveness of the lead arsenate, but gave a more uniform coverage. Cover sprays of oil, nicotine sulphate and oil, barium fluosilicate and fish oil, zinc arsenite, zinc arsenate, and calcium arsenate did not give uniformly satisfactory results. The following quantities of materials were used in 100 U.S. gals spray : lead or zinc arsenate, $2\frac{1}{2}$ lb. with $\frac{1}{2}$ lb. hydrated lime ; zinc arsenite and calcium arsenate, $2\frac{1}{2}$ lb. with 1 and $2\frac{1}{2}$ lb. lime respectively ; mineral oil, 1 U.S. gal. ; cryolite, 4 lb. ; barium fluosilicate, 3 lb. ; fish oil, 1 U.S. pt. ; nicotine sulphate, 1 U.S. pt. Oil sprays in combination with lead arsenate were valuable ovicides. They should be used when the activity of the moths is at its height but not within 30 days of lime-sulphur, nor should they continue beyond the second cover spray or they may cause injury and increase the difficulty of removal of residue from the fruit. Supplementary measures of control, such as cleaning the trees and applying chemically treated bands, screening the storage cellars, and the destruction of hibernating larvae, are important.

The arsenical residue from the standard lead arsenate spray programme (a calyx spray and 4 cover sprays) was 0·024–0·157 grains per lb. fruit at harvest. Fish and mineral oils increased the residue. The substitution of materials other than lead arsenate in the last 2 sprays did not keep the arsenic residue below 0·01 grains per lb.

Bailey (S. F.). **Thrips as Vectors of Plant Disease.**—*J. econ. Ent.* **28** no. 6 pp. 856–863, 50 refs. Geneva, N.Y., December 1935.

The part played by thrips in the transmission of diseases of plants is reviewed from the literature, and the habits of some of the more common phytophagous species and their potentiality as carriers are discussed. Only 3 species, *Frankliniella insularis*, Frankl., *F. moultoni*, Hood (*californicus*, Moult.) and *Thrips tabaci*, Lind., have been definitely shown to carry viruses, all transmitting spotted wilt and *T. tabaci* pineapple yellowspot. With the exception of the more important economic forms, little is known of the life-history of the majority of species. The Terebrantia lay their eggs in the more tender plant tissues, the larvae feed on the same plant and drop for pupation to the ground, whence the adult emerges and regains the food-plant to complete the cycle. There are many overlapping generations each season. In the Tubulifera the eggs are deposited loosely on the surfaces of the bark, leaves, etc., the larvae develop more slowly, pupation often occurs on the plant, and the number of annual generations is fewer. Adults of Terebrantia are very active and are found on many plants, whereas those of Tubulifera are larger, move more slowly, migrate little, and have a much narrower range of food-plants.

In addition to *Thrips* and *Frankliniella*, the Terebrantia includes the very large genus *Taeniothrips*, which contains most of the species of

economic importance, and these 3 genera probably have the widest distribution and greatest range of food-plants of any in the entire order. Comparative data are given of the life-histories of the known vectors of plant viruses and several other species, which, although they have not yet been studied in this respect, are suspected of being carriers, *viz.*, *Thrips imaginis*, Bagn., *Frankliniella tritici*, Fitch, *F. fusca*, Hinds, *Taeniothrips simplex*, Morison, *Heliothrips haemorrhoidalis*, Bch., *Selenothrips* (*H.*) *rubrocinctus*, Giard, *Hercothrips* (*H.*) *fasciatus*, Perg., and *Scirtothrips citri*, Moult.

From a summary of all the known facts concerning thrips proved or suspected to be carriers of plant virus, it is seen that all viruses actually or possibly transmitted by thrips are sap-transmissible. A brief description of the manner in which thrips feed is given. The greater part of the anatomical studies hitherto made deal with the adult, but as the viruses seem to be acquired in the larval stage only, and the larvae remain on the same plant whereas the adults move about and are thus likely to disseminate disease, a careful morphological comparison of the stages would probably lead to some explanation of the method of transmission. Instances are quoted in the case of *F. insularis* [*R.A.E.*, A **20** 212] and of *T. tabaci* [**19** 744] in which the incubation period of spotted wilt in immature thrips is about 10 days, whereas the adults commonly live for 20 days or more. The adults, and occasionally the mature larvae, transmit the disease, and ability to do so is retained for about 30 days in adult life. In extracted juice the virus of spotted wilt lives 4–6 hours. So far as is known the virus of spotted wilt is not transmitted through the egg stage. Except in the case of *T. tabaci* nothing is known of the thrips' capacity to exert selectivity or to exhibit specificity in transmitting a virus.

Instances are quoted from the literature of transmission (probably mechanical) by thrips of spores of fungi, bacteria and various cryptogams. A summary of life-history data is given in respect of *Hercothrips femoralis*, Reut., *Taeniothrips inconsequens*, Uzel, and *Liothrips* (*Cryptothrips*) *floridensis*, Wats., indicted as carriers, respectively, of bacterial disease of beans, pear blight (*Bacillus amylovorus*) and *Pestalozzia* sp. on camphor [*Cinnamomum camphora*], and several species of thrips are recorded as carrying fig-decaying organisms.

Although little is yet known concerning the relation of thrips to plant disease, it is suggested that, where transmission of a virus has been proved, some biological relation between it and the vectors exists. Further study will probably show that many more species, particularly among the Terebrantia, are vectors.

Boyce (A. M.). **The Codling Moth in Persian Walnuts.**—*J. econ. Ent.* **28** no. 6 pp. 864–873, 2 figs., 8 refs. Geneva, N.Y., December 1935.

Cydia (*Carpocapsa*) *pomonella*, L., is the chief pest of Persian walnuts [*Juglans regia*] in California, where plantings in 1934 totalled some 140,000 acres and produced 98 per cent. of the crop in the United States. It was first recorded as attacking walnuts in central California in 1909, when 5–50 per cent. of the nuts were affected on individual trees, though general infestation was slight until 1931. In southern California infestation was first noted in 1913, and it had reached serious proportions by 1918. By 1925 a large portion of the coastal and sub-coastal areas were more or less seriously infested, and a few infested nuts were

found in many of the interior valleys, and in 1931 there was a general outbreak. Although present on walnuts in Oregon since 1919, *C. pomonella* has not assumed economic importance there.

Owing to the fact that apples and pears have been heavily infested in California since 1880, whereas infestation on walnut was light until 1931, it is suggested that a race of the insect better adapted to walnut than the original form has been evolved. The nature and degree of injury caused and the bionomics of *C. pomonella* on walnut are discussed [*R.A.E.*, A **8** 238; **14** 406]. Infestations are built up relatively slowly, and walnuts do not become so heavily infested as apples in the same area. In untreated groves in certain areas 25 per cent. infestation is not uncommon, but 50–75 per cent. is rare. When under laboratory conditions one egg each was placed on a large number of walnuts, only 50 per cent. of the larvae gained entry, and under conditions of total daylight and outdoor temperatures and humidity, only 25 per cent. entered, whereas on apples under similar conditions 80 per cent. entered the fruit. The behaviour of the larvae is discussed from a paper already noticed [**17** 386]. The author's observations suggest that the time of day and extent to which the larvae vacate their burrows is somewhat dependent upon the prevailing relative humidity.

Control measures are essentially unchanged since recommendations made in 1919–21 [**8** 238]. Many larvae that are several days old when basic lead arsenate is applied are subsequently killed, apparently by consuming quantities of it when they vacate their burrows and wander over the surfaces of the walnuts. Owing to the habits of the larvae, a slow-acting material, such as basic lead arsenate, may be very effective in preventing actual economic injury, a small burrow on the husk not being sufficient to reduce market value. It has further been suggested that the tannin in the husk tissue, when consumed by the larva, may act as an astringent, thus increasing the efficiency of the lead arsenate. Unpublished laboratory data obtained by C. O. Persing in 1934 show that acid lead arsenate (which is too injurious to use on walnuts) is about 6 times as effective as basic lead arsenate in killing very small larvae on walnuts [*cf.* also **18** 313]. The residue problem does not arise in the case of walnuts.

Under ordinary conditions one properly timed spray affords satisfactory protection of walnuts throughout the season, whereas several are required on apples. When temperatures are high during spring and summer and walnuts mature late, a large proportion of them are infested by small larvae, the presence of which is difficult to detect, and exceptionally a second treatment may be profitably applied. To avoid this and to maintain a high enough arsenical deposit to give protection against late infestations, it is suggested that lead arsenate be wetted with specially treated oils so that the arsenical can be applied to the tree in the oil phase of the mixture, giving a minimum amount of run-off in the water phase [*cf.* below, p. 164].

In comparative tests with fluorine compounds, in which each insecticide was used at the rate of 4 lb. plus $\frac{2}{3}$ U.S. qt. of highly refined mineral oil, and $\frac{1}{3}$ U.S. pint liquid blood albumin per 100 U.S. gals. water, in a grove where infestation had amounted to 52 per cent. the preceding year, the average percentage of infested walnuts after the use of each material was: Dutox (80 per cent. barium fluosilicate), 17; natural cryolite, 13; synthetic cryolite, 9; and basic lead arsenate, 6.

Comparative tests of basic lead arsenate as a dust and spray showed the following percentages of infestation after treatment: a dust of

lead arsenate and lime (3 : 7) at the rate of about 2 lb. lead arsenate per tree, 9 ; lead arsenate as a spray at the same rate, 3 ; undiluted lead arsenate applied as a dust at 2 lb. per tree, 7 ; and at 4 lb. per tree, 6. Although dusts cannot be generally relied on for control, they give satisfactory results in some areas where infestation is apparently less severe.

For the control of *Chromaphis juglandicola*, Kalt., nicotine sulphate is included at the rate of 2 per cent. in the dust or $\frac{1}{3}$ pt. to 100 gals. in the spray. The nicotine also kills some adults and young larvae of *C. pomonella*. Calcium caseinate spreader ($\frac{1}{3}$ lb. to 100 U.S. gals.) improved the wetting and spreading qualities of the lead arsenate spray and resulted in a slight economy of material.

The timing of the spray, which is rather less important than in the case of pome fruits, is determined by the use of fermenting baits for the moths. The first treatment is applied at the first peak of egg deposition, provided that the walnuts are large enough to make contact with one another and are fairly uniform in size. An account is given of tower spraying and of the different types of towers used. Under favourable conditions, one unit applies 16,000–18,000 U.S. gals. daily, an average sized mature tree receiving about 50 U.S. gals.

Smith (H. S.). **The Rôle of Biotic Factors in the Determination of Population Densities.**—*J. econ. Ent.* **28** no. 6 pp. 873–898, 16 refs. Geneva, N.Y., December 1935.

According to Bodenheimer [*R.A.E.*, A **17** 489], the equilibrium of insect populations in nature is maintained almost entirely by abiotic factors, principally climate, and biotic factors are of little importance. In discussing these assumptions, the author deals exclusively with the average density or equilibrium position, around which population density tends to oscillate and by the displacement of which most problems of economic entomology arise, and purposely omits oscillations, pointing out that these two problems are distinct.

From the Verhulst-Peal Law it is shown that m=aD+b where a and b are constants, m=mortality and D=density. Since the equilibrium position is reached when the coefficient of mortality becomes equal to the coefficient of reproduction, which is taken as constant, the equilibrium position is determined by a density dependent factor (aD) and a density independent factor (b). Also from one of Volterra's equations it is shown that the equilibrium position is reached at $D=(\frac{n-b}{a})$ where n is the coefficient of reproduction.

It follows that the density independent mortality factors alone cannot determine the equilibrium position. Climate is probably not always a density independent mortality factor ; but the characteristic density dependent mortality factors are parasites, predators, and disease.

Flanders (S. E.). **Effect of Host Density on Parasitism.**—*J. econ. Ent.* **28** no. 6 pp. 898–900, 1 ref. Geneva, N.Y., December 1935.

A convenient method of studying the effect of host density on parasitism has been developed in the course of mass production of *Sitotroga cerealella*, Ol., and of its egg-parasite, *Trichogramma* [*minutum*, Riley]. The effect is measured by the progeny per parasite and the percentage

of parasitism under two series of environmental conditions. Each series is a duplicate of the other except that in one the host density and in the other the numbers of the parasites liberated varies. The technique employed is described. The results obtained in tests in which a total of 7,806 hosts was used showed that with increasing host densities the number of progeny per parasite is increased until a maximum is reached and maintained. It becomes constant only after the number of hosts within the sphere of action of the parasites exceeds the total reproductive potential of the latter. Within the limited area of experimental units, the number of progeny per parent decreased with the number of parasites liberated, probably owing to superparasitism. Superparasitism also lowered the rate at which the progeny per female increased with host density, so that the rate of increase was inversely proportional to the number of parasites liberated.

With single generations the maximum percentage of parasitism occurs when the host density is such that the number of the host approaches the total reproductive potential of the parasites. At lower densities, the percentage of parasitism increases as more eggs become available, whereas at high densities the percentage of parasitism decreases, since the reproductive potential is limited and is independent of the host density. With multiple generations under natural conditions the reproductiveness of the parasite is less limited and continues to be dependent upon host density, so that the increase in percentage of parasitism would be expected to continue.

LAMIMAN (J. F.). **The Pacific Mite,** *Tetranychus pacificus* **McG., in California.**—*J. econ. Ent.* **28** no. 8 pp. 900–903, 1 fig. Geneva, N.Y., December 1935.

In California there are at least 15 species of true red spider mites described in the genera *Tetranychus*, *Paratetranychus* and *Schizotetranychus*, all of which are of economic importance either in food crops or on ornamental plants, and 10 species in 7 other genera that have been included in the family TETRANYCHIDAE by various workers. The most important species of true red spiders are *Tetranychus pacificus*, McG. (Pacific mite) on deciduous fruits and grapes, *Paratetranychus citri*, McG., on *Citrus*, and *Tetranychus telarius*, L. (common red spider), in greenhouses and on vegetable crops. The identity of the various species has been confused owing to the difficulty of separating them macroscopically and to the confusion of common names. Characters distinguishing *T. pacificus* from *T. telarius* are given. Although the presence of *T. pacificus* has been known in California and Oregon since it was described in 1919 [*R.A.E.*, A **8** 145], it was only in 1927 that it was realised that it was the species attacking deciduous fruit trees, hitherto believed to be *T. telarius*.

T. pacificus has since been found responsible for most of the red spider injury in the hot interior sections of northern California and has undoubtedly been present there for many years, wrongly identified as *T. telarius*, though both species are often present on the same plant. In 1928 *T. pacificus* was found attacking grapes in the San Joaquin Valley and has since been found in most of the grape-growing sections of northern California, often associated with *T. willamettei*, McG., which is, however, only present in spring and early summer. *T. pacificus* has also been collected from lucerne, deciduous fruit trees, and a great variety of other trees and plants. The females hibernate beneath the

bark and in crevices on the food-plants from late summer to March. As many as 2,000 have been counted on one grape vine, of which 50–75 per cent. survived the winter. The first active females were found on 1st March in 1931 and 1932, but in 1933 cool weather delayed emergence until 17th March and maximum populations were not reached until August, so that there was no defoliation, which, when it occurs normally in July, is usually followed by crop injury. On emergence females feed on weeds and lay eggs on them before moving to the new vine growth when it appears. On deciduous trees the first colonies are found at the tips of the branches where they escape notice until the tree is heavily infested. Each female deposits 50–100 eggs over 2–4 weeks, and 10–14 days are required for hatching and subsequent development. Several generations may be produced, and severe injury may be caused in July and August when infestations of 600–1,400 mites per grape leaf often occur.

Of 44 recorded natural enemies of *T. pacificus*, only 2, *Scolothrips sexmaculatus*, Perg., and *Seius pomi*, Parrott, are of importance, and these only destroy small colonies in the spring.

Patton (R. L.) & Mail (G. A.). **The Grain Bug (*Chlorochroa sayii* Stål) in Montana with special Reference to the Effects of Cold Weather.**—*J. econ. Ent.* **28** no. 6 pp. 906–913, 4 figs., 4 refs. Geneva, N.Y., December 1935.

The Pentatomid, *Chlorochroa sayi*, Stål, which has been present in Montana since 1872, has become a very serious pest of wheat in the northern part of the State during the past 4 years. A comparison of climographs for the severely infested regions and from areas partly or completely free from the bug showed that temperature and precipitation have little or no bearing upon its distribution. In experiments to correlate the outbreaks with temperatures during hibernation, it was shown that at between —13° and —19°C. [8·6°–2·2°F.] death occurred in over two-thirds of the trials made in the laboratory. This is confirmed by the 70 per cent. mortality found in the field after exposure of the hibernation quarters to temperatures varying from —13·9° to —17·8°C. Observations on adults brought out of hibernation showed certain differences in the behaviour of *C. sayi* as compared with its activities in New Mexico [*R.A.E.*, A **7** 398]. They became active and fed readily soon after coming out of hibernation, but females did not lay eggs until 16–20 days later. The incubation period decreased from 14 days at 17°C. [62·6°F.] to 4 days at 32°C. [89·6°F.].

In field observations in February the bugs were scarce around Russian thistle [*Salsola*] bordering hedges, their supposed hibernation quarters, but were abundant in stubble fields and under straw dumps. When taken to the laboratory, they emerged from hibernation as soon as they were exposed to room temperature, showing a very low percentage of mortality. In March *C. sayi* was found in considerable numbers feeding on *Opuntia* at least 30 miles from any cultivated crop, this bug not having been previously recorded from cactus. Oviposition in the field began during the second and third week in May, and first instar nymphs appeared early in June. The eggs were deposited on stubble in preference to Russian thistle.

The numbers of bugs can be greatly reduced by burning infested stubble during the period between emergence from hibernation and oviposition.

Barnes (O. L.) & Frankenfeld (J. C.). **Problems in the Storage of *Anastatus semiflavidus* Gahan, an Egg Parasite of the Range Caterpillar.**—*J. econ. Ent.* **28** no. 6 pp. 917–924. Geneva, N.Y., December 1935.

Eggs of *Hemileuca oliviae*, Ckll., have been parasitised in large numbers from 1930 onwards in the laboratory in Arizona by *Anastatus semiflavidus*, Gah., and returned to north-eastern New Mexico for colonisation on infestated cattle ranges [*cf. R.A.E.*, A **21** 600].

The following is the authors' summary of the results of experiments to find methods of storing the parasites for several weeks or months without serious mortality by subjecting the host eggs to refrigeration. The egg of *A. semiflavidus* is not suitable for storage at constant temperatures of 35°, 38°, 42°, or 46°F. for long periods. In general, parasite survival decreases as the period of exposure at constant low temperature increases. The mature parasite larva, apparently in a resting condition several days after consumption of the contents of the host egg, is the most resistant stage for withstanding low temperatures for long periods. Results of refrigeration tests at 35°, 38°, 42°, and 46°F. indicated that parasite mortality increased as the temperature was lowered. Mature larvae of *A. semiflavidus* survived a temperature of 52°F. for periods of 3, 6, or 8 months, the minimum survival rate being 88 per cent.

Parasitised eggs of *H. oliviae* should be kept at approximately 75°F. for 20–40 days, or at moderate variable temperatures until the developing parasites have reached an equivalent stage of growth, before storage at 52°F. A constant temperature of 85°F. is quite suitable for parasite development following storage. Mass parasite rearing operations are easily adjusted to fit the conditions necessary to secure a minimum of mortality in storage.

Kitchel (R. L.) & Hoskins (W. M.). **Respiratory Ventilation in the Cockroach in Air, in Carbon Dioxide and in Nicotine Atmospheres.** —*J. econ. Ent.* **28** no. 6 pp. 924–933, 2 figs., 17 refs. Geneva, N.Y., December 1935.

The authors carried out an experiment by a method similar to that used by McGovran with grasshoppers [*R.A.E.*, A **20** 418], the technique of which is described, to study the effect of carbon dioxide on the amount of air and nicotine vapour passing through the tracheal system of nymphs and adults of *Nyctibora noctivaga*, Rehn. It was found that a directed tracheal ventilation from front to rear is normal in this cockroach. The influence of carbon dioxide comprises an initial stimulus, the intensity of which varies directly with the concentration, and an anaesthetic effect, which becomes noticeable after a period that varies inversely with the concentration. The great initial acceleration of ventilation is succeeded with concentrations of over 15 per cent. by a decrease; and in atmospheres containing 50 per cent. or more of carbon dioxide the insects soon become motionless. Directed ventilation does not cease on account of opening of the spiracles, but because respiratory movements stop. The anaesthesia occurs in undiluted carbon dioxide so quickly that the initial acceleration of ventilation cannot be detected. Individuals revive after being kept in closed bottles of carbon dioxide for an hour or longer.

The first reaction of the cockroach to nicotine is to close the spiracles. They reopen irregularly, and the situation when both nicotine and carbon dioxide are present depends upon the relative concentrations. Exposures to nicotine for ½ hr. or more results in the spiracles standing open in some cases, and in others in short periods of reversed ventilation. It is evident that nicotine seriously deranges the mechanism for spiracular control. The increase in toxic effects when 5 per cent. carbon dioxide is used with nicotine is undoubtedly attributable to the larger amounts of the latter that pass through the tracheal system. The results of McGovran, who found high concentrations of nicotine vapour to increase the rate of directed ventilation in grasshoppers, indicate a difference in the reactions of the two insects.

PERSING (C. O.). **A Discussion of various Oils in Spray Combinations with Lead Arsenate, Cryolite and Barium Fluosilicate.**—*J. econ. Ent.* **28** no. 6 pp. 933–940, 6 refs. Geneva, N.Y., December 1935.

A study in California in 1933 of the effect of various oils on the deposit of standard lead arsenate on apple surfaces showed that fish oils and vegetable oils were in general more effective in depositing larger amounts of lead arsenate than were straight, highly-refined mineral oils. Microscopic examinations showed a very intimate association between the oil and lead arsenate particles in combinations using fish oils and several vegetable oils, some of the particles being completely dispersed in the oil phase of the system. When straight mineral oils were used, the particles of lead arsenate were collected at the interfacial boundary between the oil and the water and were completely wetted by the aqueous phase, except at the point of contact with the oil globule. The great differences in chemical composition between animal and vegetable oils in comparison with straight, highly refined mineral oils are pointed out. The introduction of polar radicals, which are known to increase the wetting power of oils, into straight mineral oils by the addition of small quantities of stearic, palmitic and oleic acids produced lead arsenate deposits comparable with those given by the fish oils and vegetable oils. It was concluded that the wetting property of an oil is probably the most important single factor that determines its efficiency. In extensive insectary tests with larvae of the codling moth [*Cydia pomonella*, L.], oils that contained 1–10 per cent. oleic acid by volume were greatly superior to straight mineral oils in the amount of lead arsenate deposited as determined by toxicity to the larvae and by arsenical residue on sprayed fruit.

In toxicity tests in 1934 when walnuts were sprayed with various oils and adhesives and then infested with larvae of *C. pomonella*, the most effective material tested was kerosene containing 10 per cent. oleic acid, based on the amount of lead arsenate deposited and the toxicity to the larvae. The best results were obtained when lead arsenate was soaked in the kerosene before adding it to the tank, a small amount of blood albumin being previously added to the water to prevent the mixture from clinging to the sides.

In the summer and autumn of 1934 natural and synthetic cryolite and barium fluosilicate were combined with various types of oil emulsions to control *Saissetia oleae*, Bern., *Eucosma citrana*, Hb. (*Argyrotaenia citrana*, Fern.), and *Holcocera iceryaeella*, Riley, on *Citrus* in California. The oils were used in paste form, as emulsive

oils, or prepared by the tank-mixture method. The paste type is emulsified with a caseinate and the emulsive oil with an oil soluble emulsifier such as triethanolamine oleate, whereas a small amount of powdered blood albumin is required with the tank-mixture method.

In the field these various types of oils reacted quite differently when used with either cryolite or barium fluosilicate, severe flocculation occurring with certain combinations, whereas others formed fairly homogeneous mixtures. Some combinations exhibited excellent wetting and spreading qualities, but with others there was considerable beading of the spray mixture on the fruit and leaves. With some oils the deposit of either cryolite or barium fluosilicate was so heavy that the trees appeared white, whereas with other oils very little visible deposit was noted. A laboratory study was therefore made of the physical properties of spray mixtures composed of these oils in combination with cryolite and barium fluosilicate.

Other workers have recorded a difference in the performance of straight mineral oil emulsions when emulsified with ammonium caseinate as compared with triethanolamine oleate and distinguished a special type of lead arsenate flocculation produced [*cf. R.A.E.* A **23** 274]. The author's investigations on similar combinations have shown that these differences in behaviour and lead arsenate depositing qualities are due to the wetting properties of the oil. The ammonium caseinate, being practically insoluble in oil, probably exerts little effect upon the physical nature of the oil, whereas triethanolamine oleate, being polar and completely soluble in oil, greatly increases its wetting properties. With the latter type of emulsion some of the particles are at least partly in the oil phase, causing the desirable type of flocculation that prevents the run off of the lead arsenate. An almost unlimited spray deposit can be built up with this type of spray combination by an increase of primary deposit. In the case of ammonium caseinate emulsion, the lead arsenate, which is completely in the water phase, runs off with the water, and a deposit can only be built up by means of overspray. The secondary deposit is in this case the important one, though it reaches a maximum point beyond which it cannot be increased by over-spraying.

All the oils that were being used in the field with barium fluosilicate and cryolite were studied in the laboratory, observations being made on such points as flocculation in the tank, spreading, wetting and visible deposits on oranges. Insectary tests were conducted with ripe apples that had been sprayed with synthetic cryolite in combination with these oils, using newly-hatched larvae of *C. pomonella*. The results obtained in this work are discussed. Some of the oils possessed great wetting power as shown by the microscopic determinations of particles of the fluorine compounds centralised in the oil phase of the emulsion. In all cases where the compound remained in the oil phase there was a heavy visible deposit, excellent wetting and spreading and relatively high toxicity to the larvae of *C. pomonella*. The so-called emulsive oils were much more efficient in spreading and depositing cryolite or barium fluosilicate than were the other types of emulsion used. With certain of the emulsive oils better results were obtained by thoroughly mixing the cryolite or barium fluosilicate in a thin paste before adding to the tank. Two brands of emulsive oils in particular possessed, when added to an aqueous suspension of cryolite, such great wetting power that the cryolite particles passed from the water phase into the oil phase with moderate agitation.

When two immiscible liquids are brought into contact with a solid, it usually happens that one of them wets the surface of the solid to the exclusion of the other. This is known as preferential wetting. It is thought that all solids will eventually go into the phase of the emulsion by which they are preferentially wetted, regardless of the liquid by which they are initially wetted. In preferential wetting tests with barium fluosilicate, various cryolites and various types of oil, it was conclusively shown that after 5 minutes agitation all the fluorine compounds were finally contained in the phase by which they were preferentially wetted. However, in practice, it is advisable to wet cryolite or barium fluosilicate with the oil before adding it to the tank. This is due to the fact that several so-called emulsive oils do not possess adequate wetting power to cause the particles to pass from the aqueous phase into the oil.

EYER (J. R.). **Further Observations on the Attractiveness of Esters of the Ethyl Acetate Series to the Codling Moth.**—*J. econ. Ent.* **28** no. 6 pp. 940–942, 4 refs. Geneva, N.Y., December 1935.

Experiments in New Mexico indicate that fermenting sugar and vinegar baits are attractive to the codling moth [*Cydia pomonella*, L.] through their formation of certain fruity esters somewhat similar to ethyl acetate [*cf. R.A.E.*, A **19** 546]. Of about 80 of these esters recently tested, iso-butyl-phenyl-acetate and ethyl-oxy-hydrate were the most consistently attractive. The latter is formed by the hydrolysis of either sugar or vinegar, and its attractiveness may be partly due to its attendant products, ethyl alcohol, ethyl acetate and formaldehyde. The attractiveness of iso-butyl-phenyl-acetate, which results from the hydrolysis of acetic acid or vinegar, is apparently due to its being an iso-compound and to its possessing a benzene ring. Comparisons of the sex attractiveness of these two esters with fermenting cane and malt syrup showed them to be quite similar and indicated that both the esters and the fermenting sugars are food and not sex attractants. Analysis of data obtained from making daily changes in the position of the bait in individual trees and among 4 separate trees showed that the attractiveness of the bait due to its composition was 2–3 times as significant as the position in the orchard and in the syrup bait 16–18 times as significant.

HENSILL (G. S.) & HOSKINS (W. M.). **Factors concerned in the Deposit of Sprays. I. The Effect of different Concentrations of Wetting Agents.**—*J. econ. Ent.* **28** no. 6 pp. 942–950, 2 figs., 22 refs. Geneva, N.Y., December 1935.

The following is the authors' summary: The use of different materials to facilitate the wetting of plant and animal surfaces with insecticidal sprays has caused great stress to be laid on the importance of forming a continuous film of spray liquid upon the surface during spraying. The effect of formation of a film is to stop the increase in the amount of insecticide deposited upon the surface as spray liquid falls upon it. This initial or primary deposit is supplemented by a secondary deposit of the insecticide contained in the film. The various wetting agents bring about film formation after different

intervals and hence affect the total amount of deposit. Their action is also dependent upon the concentration at which they are used.

Determination of the deposit of oil and lead arsenate with different concentrations of blood albumin spreader, Kayso [calcium caseinate] and triethanolamine oleate shows that a maximum deposit is obtained, under the condition that a constant volume of each spray is applied to equal areas of wax, with a characteristic concentration of each wetting agent and not with the mechanical mixtures containing none. This indicates that the surface is altered at different rates and to different extents by the various wetting agents.

BORDEN (A. D.). **Codling Moth Control and Spray Residue Studies in California.**—*J. econ. Ent.* **28** no. 6 pp. 951–956, 3 figs. Geneva, N.Y., December 1935.

An account is given of field and laboratory studies carried out in California for the past 3 years on spray residue in connection with the control of the codling moth [*Cydia pomonella*, L.] on three varieties of apple and on Bartlett pears. The number of sprays required in northern California varies from one to six according to the district, early varieties of apple being exposed to only one brood and late varieties to two. Climatic differences also cause variations in moth populations. In the Pacific Northwest, where the peaks of emergence are closer, spray applications at 10–14 day intervals, with 8 or more cover sprays, are required. In California cover sprays number 2–5, applied at intervals of 3–4 weeks, and the occurrence of the first, second and often the third peak of emergence of the overwintered brood coincides even in widely separated areas, though this uniformity does not hold good in later peaks during midsummer. From 60 to 80 per cent. of the moths of the overwintered brood usually emerge during the 3-week period following petal fall, coinciding with the period of greatest loss of deposit from fruit growth. In one orchard the first two cover sprays during this period followed by two late cover sprays, carefully timed by bait traps, resulted in reducing the percentage of infested pears to 1·5 per cent., whereas in a second orchard, receiving only one calyx spray and three late cover sprays, although carefully timed, 15–22 per cent. of the fruit was lost. A calyx spray should be applied when 50–70 per cent. of the petals have fallen and the first cover spray 10–14 days later. An extended bloom period may necessitate a double calyx spray, the first cover following quickly after the second calyx. No substitute for lead arsenate has been found for the first two cover sprays. The use of lead arsenate without a spreader is discouraged, though an excessive use of spreader causes a reduction in deposit. On apples and pears, $\frac{1}{4}$–$\frac{1}{2}$ lb. fluxit to 100 U.S. gals. is sufficient. On Bartlett pears, which present special difficulty, 4 oz. powdered blood albumin spreader gave a higher lead arsenate deposit and better control. Oil should not be combined with lead arsenate unless other insects are present, and should not be used at all in late cover sprays. Properly timed applications of oil-nicotine gave good results as late cover sprays and reduced the lead arsenate previously deposited on the fruit.

A study of the deposit of lead arsenate on fruit and foliage during 1934 and 1935 showed that the changes in texture of the surface of the fruit materially affect the deposit. The highest deposit per inch

is attained in the calyx spray, probably owing to the roughened surface of the calyx cup and the pubescence of the fruit. From 75 to 80 per cent. of the load is often found in the calyx cup itself. As the fruit starts to grow and the surface becomes more resistant to the wetting and spreading of the spray, the deposit at each application is materially reduced. On both pear and apple foliage the deposits are more uniform throughout the season ; the heaviest deposits often occur in the last application, as young tender foliage is more resistant to wetting and spreading. The pronounced loss of deposit observed in the case of Bartlett pears is shown to be definitely correlated with a corresponding increase of fruit area in the intervals between the first three sprays.

Webster (R. L.). **Codling Moth Larvae and the Weather.**—*J. econ. Ent.* **28** no. 6 pp. 956–960, 4 refs. Geneva, N.Y., December 1935.

An attempt is made to enumerate the several factors that influence the abundance of the codling moth [*Cydia pomonella*, L.] in a single locality. The data on which these generalisations are based are for the most part drawn from daily records in the Wenatchee Valley of Washington over a period of 9 years from 1926 to 1934.

The following is taken from the author's discussion : During the 9 years' period damage to apples was particularly severe in 1929, 1931, 1932 and 1934, and it has recently been far more difficult to keep *C. pomonella* in check than during the years immediately previous to 1929. Although this may be partly due to resistance of the larvae to insecticidal treatment, a high moth population has definitely accumulated in recent years. Following great larval activity in the autumn of 1931, many larvae carried over into the spring of 1932, when great numbers of moths were caught in the traps and severe injury was anticipated. Although temperatures in May were rather low, weather in June was favourable to oviposition, and a continued emergence of moths led to the worst infestation since 1916, in spite of low temperatures in July and August. In 1933, which would normally have been a year of serious infestation, emergence was delayed by cool weather in May and June, while July and August temperatures were only slightly above normal. The population, however, was not greatly diminished, and following a particularly mild winter, emergence started early in 1934 and was particularly heavy. In March, April, May and June temperatures were 5·4°, 7°, 3·5° and 1·9°F. above normal respectively. Although in July temperatures were 1·5°F. below normal, the first brood had already built up so tremendous a population that heavy losses were incurred. August (1·1°F. above normal) was favourable to the development of second brood larvae, and the damage caused by late larvae was particularly severe in 1934. The factors that accelerated the development of the population of *C. pomonella* in 1934, in order of their importance, are : the large moth population, persisting through the unfavourable short season of 1933 ; an unusually mild winter followed by an early spring, and temperatures favourable for oviposition ; early start in emergence of females ; continued activity between broods ; early start in emergence of summer brood moths ; and temperatures favourable to development in August and September.

MARSHALL (J.). **The experimental Application of Calcium Arsenate for Codling Moth Control in an arid Region.**—*J. econ. Ent.* **28** no. 6 pp. 960–965, 6 refs. Geneva, N.Y., December 1935.

Hitherto calcium arsenate has proved less effective than lead arsenate in controlling the codling moth [*Cydia pomonella*, L.] on apple and has been more liable to cause arsenical injury. It was thought that in arid regions such as the Wenatchee Valley, Washington, calcium arsenate was more likely to be effective in controlling *C. pomonella* than in districts where precipitation is greater.

Laboratory investigations have shown that in the mixtures used calcium arsenate has been even less injurious to apple foliage than lead arsenate alone, and the addition of a suitable buffer to the spray has improved spray coverage and control of *C. pomonella*. The importance of using an optimum amount of metallic sulphate for this purpose has been demonstrated. This is in the neighbourhood of 1 lb. $ZnSO_4.5H_2O$ used with 2 lb. calcium hydrate per 100 U.S. gals.

The cost of suitably buffered calcium arsenate mixture is comparable to that of lead arsenate used alone at a similar concentration of 3 lb. to 100 U.S. gals. The most effective buffered calcium arsenate mixtures are not so adhesive as lead arsenate alone and so decrease in amount per unit area more rapidly as a result of growth of fruit and weathering. If attack by second or third broods of *C. pomonella* is serious, a greater number of buffered calcium arsenate sprays would be required than of lead arsenate alone. Although vegetable or mineral oils are incompatible with calcium arsenate, a suitable petroleum oil emulsion is quite compatible and is of value in preventing arsenical injury. The use of a small amount of buffer together with calcium arsenate and petroleum oil is indicated to secure a proper margin of safety together with better adhesion of arsenical deposit. Calcium arsenate in combination with ammonium caseinate emulsion of petroleum oil, unlike lead arsenate, gave a much greater arsenical deposit compared with the arsenical used alone or with a buffer. The deposit was also more resistant to weathering and growth of the fruit.

The poor control hitherto obtained with calcium arsenate has been found to be due in a large measure to a lack of adhesiveness. This difficulty has already been partly remedied, so that with the addition of ½ per cent. petroleum oil (70–75 sec. viscosity, 90 per cent. unsulphonatable residue), 50 per cent. better control of *C. pomonella* was secured than with lead arsenate and arsenical injury was less. The calcium arsenate mixtures so far used have been more readily removed by hydrochloric acid washing solution than lead arsenate alone. Although it has not yet been possible to increase the effectiveness of calcium arsenate to the point that lead arsenate may be improved (by the addition, for example, of petroleum oil with oleic acid and triethanolamine), it may nevertheless be of considerable use in arid apple-growing regions if present lead residue restrictions are maintained or increased.

EBELING (W.). **Progress Report on the Interval Method of Applying Oil Sprays for the Control of the California Red Scale on Lemons.** —*J. econ. Ent.* **28** no. 6 pp. 965–971, 1 fig., 3 refs. Geneva, N.Y., December 1935.

Studies of the penetration of oil into the spiracles of various stages of *Aonidiella aurantii*, Mask., and counts of the relative numbers

succumbing to treatment have suggested methods of control of this scale on lemons in California based on the proper timing of several sprays of low concentration of oil, which are less injurious to the trees, directed against the immature stages, which are comparatively easily killed. A theory of timed spraying is developed similar to that of English & Turnipseed [*R.A.E.*, A **21** 658], but differing from it in that the concentrations of oil are reduced far below those normally used to kill the adults, applications being repeated at fixed intervals, usually 2–3 times a year.

The factors upon which the effectiveness of the method used depends are discussed, and an account is given of a series of experiments begun in 1933, in which the results of spraying at fixed intervals with low concentrations of oil ($\frac{2}{3}$–1 per cent.) were compared with those of single applications with heavier concentrations ($1\frac{2}{3}$ per cent.).

Microscopic examinations made of about 60 scales in December 1933, following these applications, showed that the average number of embryos per mature scale was 0·53 where the interval between the sprays was two months, 4·55 where it was one month, and 6·05 where a single treatment was applied. If the interval is two months, the progeny of the adult scales that do not succumb to the first treatment will not be mature by the time of the second, to which they will therefore be susceptible. The adults, on the other hand, will have had time to give birth to nearly all the embryos within their bodies, and it will be practically immaterial whether or not they themselves succumb to the second treatment. No significant differences in the vigour and productivity of trees in plots sprayed according to the interval method and those sprayed in the usual way was noted, although a greater total amount of oil was applied, prolonged over a 4-months' period, than in the single treatments. It is possible that in cases of heavy infestation where 3 sprays are required the first year, 2 properly timed sprays will subsequently suffice. Nothing lighter than a Grade 4 oil will prove satisfactory in this type of treatment, as lighter oils not only deposit less but are more rapidly absorbed by the bark.

Smith (R. H.) & Persing (C. O.). **Further Report on Nicotine Vapor in Codling Moth Control.**—*J. econ. Ent.* **28** no. 6 pp. 971–975, 1 ref. Geneva, N.Y., December 1935.

Following tests made in 1934 in the control of the codling moth [*Cydia pomonella*, L.] by the use of nicotine vapour applied by means of a portable fumatorium [*cf. R.A.E.*, A **23** 179], tests were carried out in California in 1935 to determine the efficiency of open-air treatment, applying the vapour when the atmosphere was calm by means of a double fish-tail spreader fixed to the end of the discharge pipe of a blower. The vaporising chamber consisted of two brass pipes each 3 inches in diameter and 4 feet long. Air heated to about 550°F. was used to atomise the nicotine, and the current of this heated air also flowed through the vaporising chambers. The effectiveness of the treatments was determined in part by moths in fly-screen cages, placed in various parts of the treated trees, and partly by bait-pan records. Black leaf 50 (a product that is 50 per cent. nicotine alkaloid) was used. The data obtained in a number of tests with apple trees of dense and light foliage, and of varying dimensions and spacing, with different dosages and times of exposure to the vapour indicate

that it will be possible to kill the moths in an orchard at any given time by the use of 15–30 cc. Black leaf 50 per tree. The dosage required will depend on the size of the trees and upon conditions that influence the dispersion or drifting of the vapour. The highest degree of efficiency is obtained when the atmosphere is quite calm. The tests reported on were made just after sunset and before sunrise. With proper equipment, only one man is required for treating an orchard. It is thought that control of *C. pomonella* might be obtained by this method by killing the moths of the spring brood every 2, 3 or 4 days during the oviposition period, or carefully timed treatments might make it possible so to reduce the number of sprays that the removal of spray residue would not be required. The cost per tree is 1¾d. for 15 cc. and 3½d. for 30 cc. With trees 26 ft. apart, 16 minutes are required to treat an acre if the vaporiser is driven at 50 ft. a minute, and 32 minutes if it is stopped for 1 minute at each two trees treated simultaneously. The cost of an outfit is about £90.

Pratt (F. S.), Swain (A. F.) & Eldred (D. N.). **Study of auxiliary Gases for increasing the Toxicity of Hydrocyanic Gas. Part 2. Studies with Citrus-infesting Scale Insects as Indices of Toxicity.** —*J. econ. Ent.* **28** no. 6 pp. 975–983, 2 figs., 11 refs. Geneva, N.Y., December 1935.

On the basis of preliminary work with Coccinellids [*R.A.E.*, A **22** 90], similar studies have been carried out in California during the past 6 years with a view to finding some gas that would increase the toxicity of hydrocyanic acid gas to Coccids infesting *Citrus*.

The authors draw the following conclusions from these studies: Although certain chemicals in the vapour phase had a very marked stimulating effect on *Saissetia oleae*, Bern., and *Coccus pseudomagnoliarum*, Kuw., while others readily stupefied them, only one in combination with HCN increased the toxicity of the latter to any appreciable extent. This one (methyl thiocyanate) was in itself quite toxic to the scales, and it is probable that increased toxicity of the combination was due primarily to this fact. Unfortunately, serious injury to the foliage of *Citrus* resulted from this combination, even when methyl thiocyanate was used at a concentration as low as 0·02 per cent. by weight in air.

None of the gases used approached HCN in toxicity to either Coccids or Coccinellids. When scales, prior to their exposure to HCN, were exposed to a gas that had a stupefying effect on them, their susceptibility to HCN was markedly decreased, thus verifying the theory of protective stupefaction by sub-lethal concentrations of HCN [**18** 41 ; **20** 32].

Swain (A. F.) & Buckner (R. P.). **Fumigation of Citrus with a Form Tent.**—*J. econ. Ent.* **28** no. 6 pp. 983–989, 3 figs., 3 refs. Geneva, N.Y., December 1935.

It has been found that when a canvas tent is used for fumigating *Citrus* with hydrocyanic acid gas, the concentration of gas near the tent is lower than toward the centre of the tree, resulting in a poorer kill of Coccids on the outer parts of the tree. To counteract this, a frame has been devised to hold the tent a foot or so away from contact with the tree. In a series of field fumigations in California

pairs of lemon trees heavily infested with *Aonidiella* (*Chrysomphalus*) *aurantii*, Mask., were fumigated simultaneously, using vaporised HCN at 24 cc. schedule, one being covered in the regular manner, whereas on the other the tent was stretched over a frame so that no part of the tree came within 18 inches of the tent. The frame tent required about twice as much HCN. The results showed that as much as 10-15 times as high a percentage of scale survived fumigation at the periphery of the tree under the ordinary tent as under the frame. On 15th April 1935, infestation had increased so much on trees fumigated in the regular manner that it was necessary to refumigate them, but no further treatment was required on those fumigated under the frame. These results were confirmed by a large scale experiment in 1935.

Bliss (C. I.) & Broadbent (B. M.). **A Comparison of Criteria of Susceptibility in the Response of *Drosophila* to Hydrocyanic Acid Gas : I. Stupefaction Time and Mortality.**—*J. econ. Ent.* **28** no. 6 pp. 989–1001, 3 graphs, 6 refs. Geneva, N.Y., December 1935.

The following is the authors' summary : The action of hydrocyanic acid gas upon *Drosophila melanogaster*, Mg., can be measured by various criteria, two of which, stupefaction time and mortality, are here compared. Approximately constant mixtures of hydrocyanic acid and air were generated from calcium cyanide and atmospheric moisture, and adult flies were exposed to a stream of this gas for stated periods.

At the concentrations used, initial muscular paralysis or stupefaction occurred at an early stage in the poisoning, and the flies recovered completely if fumigation was then interrupted. Continuation of the fumigation led to convulsive rigor. The length of the preparalytic period for 119 flies exposed to the same treatment was distributed asymmetrically when the original time units were used, but symmetrically and normally when these were first converted to logarithms or reciprocals. The geometric mean of the stupefaction time, therefore, represented the median paralytic period and was determined for each of the 19 concentrations. At concentrations of 0·6 to 1·6 mg. per litre, the concentration (C) and the length of exposure (t) to produce this constant toxicological effect were related as $C^{0.8}t = 0{\cdot}47$. Above 1·6 mg. per litre an increase in concentration did not shorten the stupefaction time.

A relation between dosage and mortality was consistent with the interpretation that the logarithms of the individual lethal doses were distributed normally. At 9 exposure periods, ranging from 2 to 16 minutes in duration, flies were fumigated at 4 or more different concentrations. A concentration-mortality regression line was computed for each of these periods, the co-ordinates being the logarithm of the concentration and the probit of the immediate mortality when measured at the time of maximum recovery [*cf. R.A.E.*, A **22** 440]. By combining the results, the concentration (C) killing 50 per cent. of the flies could be related to time of exposure (t) by the equation $C^{1.9}t = 10{\cdot}2$ for exposure periods of 4 to 16 minutes. The relation between the length of exposure and the concentration of hydrocyanic acid depended to a marked degree upon the percentage of immediate mortality for which it was computed. At 97·5 per cent. kill, for example, the equation changed to $C^{1.3}t = 26{\cdot}3$ and was consistent with

both the present results (above 4 minutes) and those reported previously by Boyce [**17** 76]. When mortality was recorded 1–2 days after treatment instead of at the time of maximum recovery, the concentration killing 50 per cent. of the flies was related to the time of exposure by the formula $C^{1\cdot8}t = 4\cdot5$. This may be considered the effective dose, since the flies that died within 2 days of the treatment did not recover sufficiently to reproduce. The effective median concentration averaged 66 per cent. as great as that required for immediate mortality.

Jones (L. S.). **Observations of the Habits and seasonal Life History of *Anarsia lineatella* in California.**—*J. econ. Ent.* **28** no. 6 pp. 1002–1011, 1 fig., 9 refs. Geneva, N.Y., December 1935.

The life-history of *Anarsia lineatella*, Zell., was studied in 1932 and 1933 in California, where it has caused variable amounts of damage to peaches since it was last studied in 1923 [*cf. R.A.E.*, A **11** 284]. A severe outbreak occurred in 1931, when 80 per cent. of the crop was destroyed in some orchards. The larvae attack peaches, apricots, nectarines, plums and almonds. Most of the injury is caused by feeding on the fruits after they have begun to ripen, though immature fruits may be infested. Peaches are attacked in all stages of development from blossom to maturity, though most of the injury is caused just before harvest, the latest ripening varieties showing the heaviest infestation. On almonds the larvae feed largely on the shoots and have attracted little notice. Feeding on blossoms, leaf buds, twigs and shoots is of little consequence on account of rapid growth, except where nursery stock or young trees are deformed by the destruction of terminal shoots. In addition to the value of the fruit destroyed, infestation causes an increase in the cost of picking and sorting.

All stages are described. Two and in some cases three annual generations have been recorded, but there may be a great overlapping of generations, due to variations in the rate of development of individuals, particularly after mid-summer. Young larvae of the last two enter hibernation in the late summer or autumn. Most of the hibernaculae are constructed in the corky bark of the crotches of branches, particularly in one- and two-year-old wood. Others are found behind lateral buds or along the sides of twigs in depressions formed by scars. Columns of frass cover the holes where burrowing has been begun by the larvae. In 1932 the first emerged larva was observed on 20th February, and peaches began to blossom on 25th February. Blossom was fullest on 5th March, and emergence continued until 15th March. In 1933 no emergence was observed until 16th March, and larvae were found in hibernation until 17th April, whereas the blooming period began on 12th and reached a peak on 20th March. Larvae that have newly emerged from hibernation feed on buds, blossoms and shoots, causing them to wilt. Most larvae of all generations pupate along older branches on the lower parts of the tree, though a considerable number do so on the fruits, usually near the stems. Reduction in borer population by destruction of cull fruits is probably due to killing these pupae.

The eggs were deposited singly, chiefly on the fruits when these were present, or cemented to the growing tips or spurs and shoots or in the crotches of branches. The moths were not attracted to baits or light-traps.

A list is given of 10 Hymenopterous parasites of *A. lineatella* already noticed [*R.A.E.*, A **22** 157], of which all emerged from the pupae with the exception of *Euderus* (*Secodella*) *cushmani*, Crwfd., which was observed feeding on the immature larvae inside hibernaculae at all seasons of the year. *Leptothrips mali*, Fitch, was predacious on the eggs.

Lewis (H. C.). **Factors influencing Citrus Thrips Damage.**—*J. econ. Ent.* **28** no. 6 pp. 1011–1015, 1 fig. Geneva, N.Y., December 1935.

The amount of injury caused by *Scirtothrips citri*, Moult., to navel oranges in central California varies considerably from season to season. Charts, made in an attempt to determine the chief factors limiting the distribution of the thrips and the amount of damage it causes, show the mean daily temperature and daily rainfall during the period of the first two generations of thrips during the six-year period 1929–1934, and the occurrence of the stages of the thrips for each season in relation to the time of orange blossoming and the critical period of fruit susceptibility to severe injury. The latter period corresponds with the normal appearance of the second generation of larvae. It was seen that high temperatures at this time resulted in increased injury whereas low temperatures had the reverse effect. Rainfall and weather during the spring previous to this period did not appear to influence damage, and the abundance of thrips then was no certain index to the amount of damage to be expected. The injury is limited to the outside wall of fruit exposed to strong light. Groves on sandy soils show much greater thrips abundance and injury than those on heavy soils in the same locality, probably partly owing to reflected heat from the warmer soil. Although other varieties of *Citrus* sometimes suffer, injury is invariably most severe on navel oranges. As the thrips breed and feed freely on new growth, they are most abundant on vigorous food-plants. An irregular flush of new growth when small fruits are present may attract the thrips away from the latter and reduce injury. As it is thus impossible to forecast seasons of light or severe damage, and all control measures have to be undertaken against *S. citri* well ahead of the critical period, it is necessary to carry them out annually in order to make sure of a high grade crop.

Michelbacher (A. E.). **The economic Status of the Garden Centipede, *Scutigerella immaculata* (Newp.) in California.**—*J. econ. Ent.* **28** no. 6 pp. 1015–1018, 3 refs. Geneva, N.Y., December 1935.

This is a review of the control measures employed against *Scutigerella immaculata*, Newp., which is a serious pest of germinating crops in the field and under glass in California [*cf. R.A.E.*, A **20** 357 ; **21** 588]

Woglum (R. S.) & Lewis (H. C.). **Notes on Citrus Pests new or seldom injurious in California.**—*J. econ. Ent.* **28** no. 6 pp. 1018–1021. Geneva, N.Y., December 1935.

Scarring of grapefruit reported in 1934 from California and Arizona was found in 1935 to be due to *Frankliniella moultoni*, Hood (*californicus*, Moult.), adults of which migrate from lucerne or other green fields before or during March. The eggs are laid in the epidermis of the mature fruit, and during less than two weeks in early April larvae hatching from these completely silvered most of the mature fruit on

some trees. The inside fruit was most affected, especially in the lower two-thirds of the trees. Orchards adjacent to lucerne fields were more subject to attack both in 1934 and 1935. For 28 years the larvae have been known to develop in *Citrus* bloom in California without causing damage to immature fruit, but injury to small grapefruit has recently been observed both in the Imperial Valley, California, and in Arizona, where as much as 10 per cent. of the young fruit was so severely injured as to fall. Fruit in clusters alone suffered. If the bloom of a cluster where larvae are feeding does not all drop simultaneously, the thrips concentrate on the remaining blooms and feed on newly-formed fruit for lack of more suitable food. All affected fruits drop off.

A serious outbreak of *Xylomyges curialis*, Grote, occurred during the spring of 1934 on a large *Citrus* plantation near Woodlake, California, where the larvae destroyed the bloom, young fruit and new leaf growth over a considerable area. What remained of the old crop of mature Valencia oranges was also attacked. In 1935, though the damage was more widespread, it was nowhere so severe, owing to the application of cryolite and barium fluosilicate dusts. In 1934 pupation took place in April. Pupae collected in May from earthen cells in the ground beneath the trees gave rise to adults in the following January–March. In the field, moths appeared in January and laid eggs on the foliage of *Citrus*. The newly-hatched larvae dropped to the ground or cover crop, on which they fed throughout March. Warm weather in April 1935 accelerated feeding, and the partly grown larvae migrated to the trees as the cover crops dried up or were disked under. Here they fed preferably on the ovary of the bloom, often eating a hole in the blossom to remove the newly-formed fruit. Tender leaves, green bark of new shoots and mature fruit are also attacked. The larvae feed actively by night and day and appear never to leave a tree until mature. They have usually matured and dropped to the ground within 10–14 days after first being observed. The new crop of small oranges and the mature crop of Valencias may be almost completely destroyed within a period of 10 days.

Although *X. curialis* was the species mainly responsible for damage, other cutworms, including *Lycophotia margaritosa*, Haw., were associated with it on cover crops. The latter became abundant and injurious in a few *Citrus* groves in 1935, when it was also injurious in southern California. In several instances larvae of *Symphasis signata*, Hagen, were found to have pupated in cocoons within the pupal cells of *X. curialis* or adults were reared from them. This is the first known record of a Mantispid being parasitic on cutworms.

Adults of *Plusia* (*Autographa*) *brassicae*, Riley, were extremely abundant in *Citrus* groves in Central California in April 1935, when they deposited eggs on cover crops, and early in May a large number of the larvae ascended the orange trees in a few groves. They attacked the new growth and young fruit, and reached maturity in late May. Infested groves were dusted with cryolite or barium fluosilicate. The abnormal abundance of the moths has not been accounted for, and no connection was found between the type of cover crop and the injury caused, although the time of disking may have been an important factor. Larvae of *Tortrix* (*Cacoecia*) *argyrospila*, Wlk., which have been fairly abundant locally on grapefruit and Valencia oranges for several seasons, roll the leaves of terminal shoots without so far causing damage of consequence.

Orr (L. W.). **A Correction in the recorded Hibernation Habits of two Species of *Ips* Bark Beetles in Minnesota.**—*J. econ. Ent.* **28** no. 6 pp. 1021–1022, 5 refs. Geneva, N.Y., December 1935.

Evidence collected in Minnesota in 1934 and 1935 is presented to show that *Ips pini*, Say, and *I. grandicollis*, Eichh., leave infested pines in autumn and actually pass the winter in litter rather than under the bark of the trees in which they have developed as was hitherto believed [*cf. R.A.E.*, A **7** 430; **21** 252]. Throughout the two seasons' investigations in various localities, no living individuals were found under the bark during the winter. There were indications that where a young brood meets with cold weather before reaching maturity in an infested tree it is unable to survive winter temperatures prevailing in Minnesota. From a sample of litter about 2 ft. square taken on 25th March 1935 from the base of a large Norway pine [*Pinus resinosa*] killed by beetles in the summer of 1934, 28 living adults of *I. pini* and 10 of *I. grandicollis* were recovered. It is thus obvious that cutting and treating trees killed by the beetles during the late autumn or early spring will not destroy them, and that such work must be done between May and October when the trees are known to be actually infested.

Painter (R. H.), Snelling (R. O.) & Brunson (A. M.). **Hybrid Vigor and other Factors in Relation to Chinch Bug Resistance in Corn.**—*J. econ. Ent.* **28** no. 6 pp. 1025–1030, 1 fig., 6 refs. Geneva, N.Y., December 1935.

A distinction is made between injury to maize seedlings caused by the first brood of *Blissus leucopterus*, Say, and that to more mature plants by the second and sometimes by the third. In most localities, under favourable conditions, the first type of injury can be controlled by suitable barriers that hinder migration of the bugs in their wingless stage, but apart from natural environmental factors, the resistance of the crop itself is the only check to the second type of injury. The relative importance of the two types varies with environment and to some extent with seasonal conditions.

Observations on various varieties of maize in Oklahama and Kansas show that hybrids generally are markedly more resistant to both types of injury than their parent inbred lines. As an average of all combinations, 13·2 per cent. of the hybrids and 59·3 per cent. of the inbred lines had been killed by 12th July 1934 in Kansas, the corresponding figures for Oklahama being 17·4 and 49·1. The varieties of maize tested showed a range of susceptibility and resistance which, though smaller, is comparable to that found in *Sorghum*, there being a striking similarity in outstanding resistance in the case of F_1 hybrids as compared to inbred lines in both crops.

Bronson (T. E.). **Observations on Winter Survival of Pea Aphid Eggs.**—*J. econ. Ent.* **28** no. 6 pp. 1030–1036, 2 figs. Geneva, N.Y., December 1935.

A series of experiments was carried out in Wisconsin during the four winter periods of 1929–33 to determine the relation of temperature to the survival of overwintering eggs of *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) on leaves and stems of lucerne under various conditions of exposure.

The following is taken from the author's summary and discussion of the results obtained : Low or sharply fluctuating winter temperatures did not cause a low survival of the eggs. Fewer eggs hatched under a wooden cover than anywhere else, probably owing to lack of contact moisture in the soil and the exclusion of sunshine in the spring. The highest percentage of eggs hatching in this situation followed the lowest and most fluctuating temperatures, which were recorded in the winter and spring of 1930. Eggs hatching from an exposed situation, which were occasionally protected by snow, gave the highest average for all situations during the 4 years of observation. Cool, cloudy weather during the period just previous to hatching resulted in low survival of protected eggs from which the coverings (of hay) had recently been removed, but had no apparent adverse effect on the hatching of exposed eggs. Warm, sunny weather during this period resulted in a closely comparable survival of eggs in both protected and exposed positions. As the result of poor condition of the eggs placed in hibernation in 1932, survival in 1933 was very low, but the ratio of hatching between exposed and protected eggs remained the same.

The rate of survival of all eggs under observation during the four years of varied weather conditions was 26·8 per cent. ; for all eggs except those covered against sun and precipitation, 30·3 per cent. ; and for all exposed eggs 33·1 per cent. The survival for individual lots ranged from 5·5 to 49·5 per cent.

Carter (W.). **Studies on the biological Control of** *Pseudococcus brevipes* **(Ckl.) in Jamaica and Central America.**—*J. econ. Ent.* **28** no. 6 pp. 1037–1041, 4 refs. Geneva, N.Y., December 1935.

No effective biological control factor is at present operating on *Pseudococcus brevipes*, Ckll., in Hawaii, where it is of great importance in relation to pineapple wilt [*cf. R.A.E.*, A **21** 64]. Coccinellids are of some value for short periods in the middle of large fields where ants are absent, and spiders and a grasshopper, *Conocephalus saltator*, Sauss., occasionally prey upon the mealybugs. The Cecidomyiid, *Lobodiplosis pseudococci*, Felt, collected in Mexico in 1930 has become established, but appears to be of minor significance. An account is given of explorations in Central America, where *P. brevipes* is believed to have originated, and in Jamaica, carried out over a period of 4 months in 1932 in the hope of finding parasites of this Coccid. In Jamaica, there was a complete absence of parasites in all the material collected. Pineapples are grown in small isolated plantings instead of in corporate holdings as in Hawaii, and the ant, *Pheidole megacephala*, F., which protects the Coccids there, is lacking. In Jamaica and throughout the Central American area visited, colonies of *Pseudococcus brevipes* of any size were invariably associated with *Solenopsis geminata*, F., and infestations as heavy as any occurring in Hawaii were found. Where *S. geminata* was not present, colonies of *P. brevipes* were rare and small.

Conditions under which pineapples are cultivated in Guatemala and Honduras, where they are found in isolated patches on the coastal plain and in the highlands, are described. Among predators on *P. brevipes*, *Scymnus bilucernarius*, Muls. (*Nephus pictus*, Gorh.) was universally distributed except at the highest elevations, without

appearing to exercise control, and *Brachyacantha* sp. was rare in the lowlands. The Drosophilid, *Pseudiastata nebulosa*, Coq., was found throughout Guatemala except in the highlands and was often very numerous. It occurs on all parts of pineapple plants above and below the soil line. Its minimum host requirements are large, 7 individuals consuming over 100 medium and large-size mealybugs during the last half of their larval lives, but it fails to control them, apparently because it is parasitised by a Chalcid. Cecidomyiids, which are common in the lowlands, were found attacking *P. brevipes* in large numbers, but were only a minor factor in control. No definite evidence of parasitism of *P. brevipes* was observed, though two Chalcids, said to be new species, were bred from mealybug material, and an attempt was made to ship them to Honolulu. One did not emerge, and the other failed to establish a colony.

It is pointed out that the established criteria for biological control are inadequate in the case of insects carrying disease or toxins, such as pineapple wilt, as the populations must be reduced to a level that controls the incidence of the associated disease as well as that of the insect itself. Thus effective biological control of *P. brevipes* could only be brought about by a combination of extremely effective predators and parasites, and these appear to be lacking.

Roaf (J. R.) & Mote (D. C.). **The Holly Scale, *Aspidiotus britannicus* Newstead and other Insect Pests of English Holly in Oregon.**— *J. econ. Ent.* **28** no. 6 pp. 1041–1049, 1 fig., 20 refs. Geneva, N.Y., December 1935.

Aspidiotus britannicus, Newst., is the most important pest of English holly (*Ilex aquifolium*) in Oregon, where the commercial holly industry is of considerable importance. Infested plants may be seriously weakened by this scale, and its presence detracts from their ornamental value. Other plants occasionally attacked are *Prunus laurocerasus* and box (*Buxus sempervirens*), and a list is given of food-plants recorded in other localities. The eggs and adults of both sexes are described, those found in Oregon differing slightly from the previous descriptions of this Coccid. The seasonal life-history of both sexes is shown in a chart for 1933 and part of 1934 ; development in 1934, following a mild winter and early spring was about 2 months in advance of 1933, when the winter had been relatively severe and the spring late. The female lays about 100 eggs in the late spring and summer, these hatch in about 4–6 days, and hibernation occurs in the immature stages. There is one generation a year on holly growing out of doors.

The chief natural enemies are *Aphytis* (*Aphelinus*) *mytilaspidis*, LeBaron, and *Aspidiotiphagus citrinus*, Crwf. The larva of *Aphytis* feeds externally on the body of the host underneath the scale cover, from which it emerges without making a hole. The larval and pupal stages of *Aspidiotiphagus* are passed inside the body of the host, from which the adult emerges through a hole in the cover. Almost all the scales in certain infestations have been found to be attacked by one or both of these Aphelinids during late spring or early summer, but only the young individuals are affected. Both parasites hibernate as larvae and pupae within the host, the adults emerging with the first warm weather. When most of the scales have died, the parasites become reduced in numbers until October or November, when the scales again reach a suitable stage. In greenhouses, where warmer

conditions favour continuous reproduction of the parasites, *A. britannicus* does not become a serious pest.

None of the three materials used for treating cut holly since 1931 has proved entirely satisfactory. Good results were obtained with sprays of a 3 per cent. emulsion of oil (viscosity 75 Saybolt, sulphonation test not less than 85) applied in the early spring to growing holly. Limited tests indicate that fumigation with calcium cyanide may be of value.

Tortrix (*Cacoecia*) *rosaceana*, Harr. (oblique banded leaf-roller) and *Coccus hesperidum*, L., are minor pests of holly in Oregon.

YOUNG (H. D.), WAGNER (G. B.) & COTTON (R. T.). **The Vacuum Fumigation of Flour Products with Hydrocyanic Acid.**—*J. econ. Ent.* **28** no. 6 pp. 1049–1055, 4 figs. Geneva, N.Y., December 1935.

Tests during the summer and autumn of 1934 to ascertain the dosage of hydrocyanic acid gas required for vacuum fumigation of various types of flour were conducted chiefly in a vacuum tank of 14 cu. ft. capacity, holding, when full, about 500 lb. flour, the results being checked in a large vacuum tank of 2,550 cu. ft. capacity. For determining the effect of fumigation on *Tribolium confusum*, Duv., 1 oz. tin salve boxes with copper-screened tops and bottoms containing about 30 beetles each were buried inside bags of flour. In two experiments in the small tank ten 48 lb. bags of flour were fumigated for 1 hour with a dosage of $1\frac{1}{8}$ oz. liquid HCN. In the first experiment the vacuum was dropped from an initial vacuum of 27 inches to zero as soon as the fumigant was introduced, and no adults or larvae of *T. confusum* buried in the middle of the bags of flour were killed; but in the second the vacuum was held for 10 minutes after the fumigant was added, and both adults and larvae were killed. Gas concentrations taken at 10-minute intervals throughout the experiments showed that when the vacuum is held much greater absorption takes place, and with greater rapidity. Thus the amount of absorption is indicative of the efficiency of fumigation. As more fumigant was required in the large tank in proportion to its size to obtain similar results, and only 26 inches of vacuum could be obtained in it as compared with 29 inches in the small one, it was concluded that the initial degree of vacuum had a marked effect on the efficiency of fumigation. In a further series of tests in the 14 cu. ft. tank, a dosage of $\frac{1}{8}$ oz. of liquid HCN gave a complete kill of adults of *T. confusum* buried in 48 lb. bags of flour with a 29-inch initial vacuum and 1 hour's exposure, whereas with only a 26-inch vacuum $\frac{3}{4}$ oz. was required to kill all. A study of the absorption of HCN by flour demonstrated that it increases linearly with the vacuum.

The amount of gas a given amount of flour will absorb was found to vary with the concentration in the tank. One bag of flour absorbed 72 per cent. of the gas present in the 14 cu. ft. tank after 1 hour's exposure to a dosage of $\frac{1}{8}$ oz. HCN under a vacuum of 28 inches, whereas two or more bags absorbed only slightly more than one. Data of absorption by different quantities of flour over a period of 50 minutes when fumigated with a constant dosage of $\frac{5}{8}$ oz. of hydrocyanic acid in the 14 cu. ft. tank show that the dosage should be calculated in relation to the quantity of flour rather than the size of the tank. The temperature of the flour had no effect upon the

absorption by it of HCN, when twenty 12 lb. bags were fumigated at 54°, 57°, and 66°F. with a 1 oz. dosage for a 1 hour period. However, none of the larvae and only 12 per cent. of the adults of *T. confusum* buried in the bags of flour were killed when fumigated at 57°F., whereas all were killed when fumigated at 66°F.

Although it is difficult to recommend a dosage that will be effective under all conditions, for general purposes it is believed that 8 oz. to 10,000 lb. flour for a 3-hour exposure will be effective against all stages of *T. confusum*, based on the use of a 28-inch vacuum and flour temperatures of 70°F. or higher. In the locality in which the experiments were conducted atmospheric pressure ranged from 29·1 to 29·3 inches during the period involved, so that the recommendation of a 28-inch vacuum corresponds to a residual pressure of 1·1–1·3 inches of mercury.

MacLeod (G. F.). **Consideration of the Value of Field Plot Technique Studies for Entomologists.**—*J. econ. Ent.* **28** no. 6 pp. 1058–1061, 1 fig. Geneva, N.Y., December 1935.

The value of attempts to determine some of the factors affecting the results of entomological field experimental work is indicated, and it is suggested that the contradictory results so often obtained with major problems covering large geographical areas may be due to faulty experimental technique as well as to variable environmental conditions. Where the effects of insect injury are to be measured in terms of comparative yields, many valuable suggestions may be gleaned from a study of the technique employed by agronomists dealing primarily with soil heterogeneity and crop yield. The quantitative relations of insect injuries to yield variations in plots treated with dusts and sprays introduces additional problems.

In experiments designed to measure, in terms of yield differences, the value of modifications in the potato spraying schedule, which were conducted over a period of 5 years in various sections of New York State, an attempt was made to evolve a uniform plan so that results from different places might be comparable. The general experimental plan followed was to use 4 or 6 row plots, the entire length of the rows. At least 4 replications were set up across the field, with 5 or more yield and count areas in parallel strips across all plots. Sources of error, such as drifting of dust materials and the mechanical injury caused to plants from dusting and spraying operations, are discussed. The use as controls of plots sprayed with water only, instead of entirely untreated plots, was tried in an attempt to compensate for this injury. The difference in yield between water-treated and untreated plots was a reduction of 10–30 bushels of potatoes per acre due to wheel injury. The theory that differences between treated and untreated plots in experiments on relatively small plots might be unduly enlarged by concentrations of insects repelled by Bordeaux mixture was tested by O. D. Burke, who sprayed 12-row plots between 24-row check plots and compared the results with those obtained from the usual 6-row strips. No significant differences were shown. Although it is usually true that where differences due to treatments are not plainly visible the results are unimportant to growers, it is possible for a field experiment, owing to faulty planning, to show visible differences, the interpretation of which is extremely hazardous, if not impossible.

Becker (W. B.). **Some Observations on the overwintering Habits of the American Elm Bark Beetle,** *Hylurgopinus rufipes* **Eichh.**—*J. econ. Ent.* **28** no. 6 pp. 1061–1065, 2 figs. Geneva, N.Y., December 1935.

Adults of *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., hibernate in Massachusetts in short tunnels in the bark of apparently healthy elm trees. The entrance holes are in the crevices, and the tunnels are generally mined in the outer layers of the bark in any direction with relation to the grain, though they often go directly in toward the sapwood, scoring it slightly. Wherever the cambial region is touched, the sap flows from the wound and causes the beetle to start another tunnel elsewhere. Further examination of this type of gallery in 1935 showed that a brown spot ¼ inch in diameter had formed around each of these punctures in the sapwood.

The egg-galleries differ from the winter tunnels; they are mined in the inner bark and are of the forked transverse type, having their entrance holes near the centre, and extending more or less across the grain of the bark with egg niches on both sides from which the larval galleries extend. The first winter tunnels were observed on 29th September 1934 and 23rd September 1935 on the bark of American elms [*Ulmus americana*] in Massachusetts. Young adults extracted from these winter galleries later constructed egg-galleries in logs in the laboratories and gave rise to another generation. Most of the winter tunnels occur on the trunks of elm trees near the ground level or on exposed roots, thick bark in the crotches of low forks being very attractive. Most of the beetles had finished tunelling by 5th November 1934. When extracted from infested trees during the winter, they took 1 hour at room temperature to revive. Hibernating beetles showed activity when disturbed on 16th March 1935, when the temperature reached a maximum of 68°F., and the first signs of resumed mining were observed on 19th April (maximum temperature 64°F.). Active digging in winter tunnels was observed on 27th April, when the temperature reached 86°F. for a short time. On 11th May (65°F.) beetles were seen crawling on the bark and on 13th May (73°F.) the first flight was observed. On 20th May (68°F.) beetles attacked trap logs and began characteristic egg-galleries, but no borings resembling egg-galleries were ever observed in the bark of living healthy trees. Once the egg-galleries in logs were well started, beetles were no longer found tunnelling in the bark of living trees. Only one generation was reared during the summer of 1935, eggs being laid in late May and June and the adults emerging in August. No beetles were seen in the open after the egg-galleries were started until the first adults of the new generation emerged. Although no larvae were found overwintering, it is thought that early emerging adults may start a second generation that might pass the winter in the larval stage.

Metzger (F. W.). **Attraction of Bait used in Japanese Beetle Traps increased by the Addition of Phenyl Ethyl Alcohol.**—*J. econ. Ent.* **28** no. 6 p. 1072. Geneva, N.Y., December 1935.

The addition of ½ part by weight of phenyl ethyl alcohol to a combination of 10 parts geraniol and 1 part eugenol used as a bait in traps for *Popillia japonica*, Newm., increased the average catch of the beetles

by 32·19 per cent., at the same time increasing the cost by only 11·3 per cent. on the basis of the prices in May 1935. The commercially available form of this alcohol, which is an important constituent of otto of roses and of geranium and several other essential oils, varies widely in composition, and the use of a grade having the following specifications is recommended: specific gravity at 25°C., 1·108; refractive index, 1·531 at 20°C.; boiling point, 217·5–218·5°C.; solubility in 50 per cent. ethyl alcohol, 1 in 2 parts.

Poos (F. W.). **New Host Plants of the Potato Leafhopper, *Empoasca fabae* (Harris), and their probable Significance.**—*J. econ. Ent.* **28** no. 6 pp. 1072–1073. Geneva, N.Y., December 1935.

Empoasca fabae, Harr., which has been reared experimentally from more than 50 food-plants under field conditions in Virginia, was observed during 1935 for the first time breeding on the tender growth of oak and hickory from South Carolina to New York. Observations of nymphs collected between June and September and reared to the adult stage indicate that these trees, from which no other species was reared, are furnishing a constant supply of adults for the reinfestation of such crops as lucerne, beans and potatoes, which mature at varying intervals during the growing season. Adults of *E. fabae* were first taken at trap lights in Virginia on 7th May, and nymphs appeared on oak and hickory on 8th June, though they had probably been present earlier. A large brood of adults was oberved on these trees on 14th June, and this has been the approximate date for 4 years at which large collections of adults have been taken in trap lights. It is suggested that populations of the Jassid are built up on these trees during its northward migration each spring and before it appears in destructive numbers on commercial crops. As it has not been observed to develop on older leaves and twigs, it is unlikely that it overwinters on these trees in the egg stage.

Tischler (N.). **A simplified Roach Trap.**—*J. econ. Ent.* **28** no. 6 pp. 1073–1074. Geneva, N.Y., December 1935.

A trap consisting of a hollow truncated cone in porcelain, 7½ inches in base diameter, 4 inches in rim diameter and 3 inches in height, has been designed as an improvement on the type of trap hitherto used for catching cockroaches. Pyrethrum powder or sodium fluoride may be placed within the trap to kill the insects, though any inert fine powder will also destroy them if used in sufficient quantity to cover their bodies. The trap can also be made from glass, smooth galvanised tin, thick cellophane, celluloid or stiff paper waxed on the inner surface.

Hough (W. S.). **Apple Trees affected by frequent Sprays of Summer Oil.**—*J. econ. Ent.* **28** no. 6 p. 1075. Geneva, N.Y., December 1935.

Following the application in 1935 of a calyx and 3 cover sprays of lead arsenate (3 lb. to 100 U.S. gals.) in May and June, arsenical injury to foliage became evident in July on certain apple trees. In June 1934, these trees had received 5 cover sprays at intervals of 7 days in each of which the following materials were used per 100 U.S. gals.: 1 lb. copper sulphate, 3 lb. hydrated lime, 5 lb. of a nicotine compound and

2 (3 in the fifth spray) U.S. qts. Orthol K oil emulsion. Soon after the fourth cover spray of lead arsenate was applied in late July 1935, leaves began to drop on the weakened trees and by late August most of the foliage on all the trees that had received the oil sprays in 1934 had fallen. The contrast with the adjacent trees that had not received the oil in 1934 and retained most of their foliage was marked. Although the foliage of the oil-treated trees had shown no visible effect in 1934, it appears that the trees had been weakened by failure of the leaves to function normally and had entered the winter undernourished. It is well-known that arsenical injury on apple trees appears first and most severely on the foliage of weak trees.

STEINER (L. F.). **An improved Codling Moth Trap.**—*J. econ. Ent.* **28** no. 6 pp. 1075–1076. Geneva, N.Y., December 1935.

In an attempt to find a trap for the codling moth [*Cydia pomonella*, L.] that would retain the advantages of the wide mouth quart jar and 4-mesh cover developed by Yetter [*R.A.E.*, A **18** 388] for use against the oriental fruit moth [*Cydia molesta*, Busck] and increase its efficiency, two of the jars were joined together securely enough to prevent breakage and yet so that each could be emptied independently. Traps of this type proved 80 per cent. more efficient than the single jar in preliminary tests in 1934 and equalled the best of the other types of trap. With this trap two ages of bait solution, or two different baits can be used simultaneously. A more uniform level of attractiveness of fermenting baits, so important when traps are used for timing sprays, can be maintained by this means and the introduction of spurious peaks in the emergence or activity curve avoided. When used for the codling moth, the jars should be covered with a 3-mesh screen if larger insects are troublesome.

RICHARDSON (H. H.). **The Effectiveness of various Derris and Cube Products for Control of the Red Spider on Greenhouse Plants.**—*J. econ. Ent.* **28** no. 6 pp. 1076–1078. Geneva, N.Y., December 1935.

In small scale tests on tomato plants infested with *Tetranychus telarius*, L., sprays of commercial acetone extracts of derris diluted with water containing 0·25 per cent. by volume of sulphonated castor oil (75 per cent. product) [*cf. R.A.E.*, A **21** 660] to give rotenone contents of 1–15,000, 1–25,000 and 1–50,000 by weight and total extractives of approximately 1–4,000, 1–6,350 and 1–12,500 killed 100, 98·3 and 93·7 per cent. of the mites respectively. Sulphonated castor oil gives good wetting power to the spray, though itself only slightly toxic, and does not cause deterioration of derris residues. Commercial acetone extracts, however, deteriorated during storage, and they form precipitates that clog the sprayer. It is shown from the data given in comparison with work already noticed [**20** 519] that undeteriorated derris extracts are more toxic to *T. telarius* than equivalent quantities of pure rotenone, increases in the concentration of which beyond 0·02 per cent., which produced inadequate mortalities, failing to increase the kill to any extent. It is therefore concluded that dilution of acetone extracts of rotenone is not a suitable method of obtaining a fine suspension, and that the true effectiveness of rotenone is not indicated by a spray in which the rotenone is in crystalline form. It is further

suggested that rotenone in a much finer condition of dispersion is likely to be more toxic to *T. telarius*.

A dust containing derris extract in diatomaceous earth prepared to give 0·5 per cent. rotenone or 1·8 per cent. total derris extractives killed only 2 per cent. of 321 mites on hollyhocks in the greenhouse.

In a series of small scale tests comprising 5 lots of 100 mites each against *T. telarius* on cucumber, suspensions of finely ground derris root (2·9 per cent. rotenone and 16·7 per cent. total carbon tetrachloride extractives) at a concentration of 0·25 per cent. by weight (rotenone approximately 1–14,000) in combination with sulphonated castor oil (1–400) gave an average (weighted) kill of 92·4 per cent. of adult mites. In another series with the same concentration of derris powder but with twice the concentration of sulphonated castor oil, the average mortality was 99·2 per cent. These two series gave averages, respectively, of 86·2 and 97·6 per cent. kill of nymphs. *Thrips tabaci*, Lind., on cucumber was also killed, but no counts were made.

Suspensions of powdered cubé root (5·3 per cent. rotenone and 17·3 per cent. total carbon tetrachloride extractives) at the rate of 0·25 per cent. (rotenone approximately 1–8,000) in combination with sulphonated castor oil (1–400) gave an average kill of 97·2 per cent. and with twice the amount of castor oil 99·2 per cent. of the adults, the average mortalities for the nymphs being 96·6 and 99·5 per cent. respectively. The derris root powder suspensions with sulphonated castor oil were as toxic to mites 6 days after preparation as when freshly prepared. There appeared to be no advantage in soaking the powder in cold water before spraying or in boiling the suspension for a few minutes before diluting it with the spray. The suspension was much less effective when used without a wetting agent. In tests carried out at Ohio in June 1935 with a lower concentration of derris powder (0·12 per cent., rotenone about 1–30,000) and a slightly higher concentration of sulphonated castor oil (1–300) a kill of 98·4 per cent. of 1,418 adults and 96·4 per cent. of 256 nymphs was obtained. With a lower concentration of castor oil (1–400) the effect was not so great. A spray containing lauryl and mixed thiocyanates (believed to be near 0·083 per cent.) with sulphonated fish oil as a wetting agent produced 94–99 per cent. mortality without apparent injury to the plants.

Nelsen (O. E.). **The Development of *Melanoplus differentialis* under Out-of-door Conditions (Orthoptera ; Acrididae).**—*Arch. Soc. Biol. Montevideo* **7** pp. 1961–1976, 3 pls., 1 chart. Montevideo, 1932. [Recd. January 1936.]

When eggs of *Melanoplus differentialis*, Thomas, are kept at a constant temperature of about 25°C. [77°F.], a diapause usually occurs in the course of embryonic development. To see if a similar phenomenon occurs in the field, a study was made of the development of eggs laid in early autumn and kept out of doors under climatic conditions obtaining in Philadelphia. There was no definite diapause and development proceeded throughout the autumn, winter and spring, whenever the temperatures rose above the developmental zero of any particular stage.

In the laboratory, eggs kept at low temperatures immediately after deposition and then at 22–25°C. [71·6–77°F.], developed without any diapause.

De Leon (D.). **The Biology of** *Coeloides dendroctoni* **Cushman (Hymenoptera-Braconidae) an important Parasite of the Mountain Pine Beetle** (*Dendroctonus monticolae* **Hopk.).**—*Ann. ent. Soc. Amer.* **28** no. 4 pp. 411–424, 1 fig., 8 refs. Columbus, Ohio, December 1935.

The following is taken from the author's summary: *Coeloides dendroctoni*, Cushm., a solitary Braconid, is the most important parasite of *Dendroctonus monticolae*, Hopk., in lodgepole pine [*Pinus contorta*] in Montana and western white pine [*P. monticola*] in eastern Washington and Idaho. It is not known to attack it in western yellow pine [*P. ponderosa*]. The average percentage parasitism ranged from about 4 to 32, depending on the age of the infestation, but in individual trees it frequently reached 90. The life-cycle varied from about 4 weeks to nearly a year. The principal emergence of the parasite and parasitism of the brood of *D. monticolae* occurred during June. Most of the larvae of the parasite overwintered, but some pupated immediately after feeding was finished and gave rise to adults during July and August. There was also some parasitism of the brood of the beetle during August and September. The immature stages are described, and notes on the habits of the adults given. Two secondary parasites, *Eurytoma* sp. and *Gelis* sp., were reared from the cocoons of *C. dendroctoni* in Montana. The apparent reasons for the low efficiency of the parasite are given, and it is recommended that measures for the control of *D. monticolae* on *P. contorta* should be carried out in the autumn, when relatively few parasites will be injured [*cf. R.A.E.*, A **23** 387]. When applying control measures to *P. monticola*, the trees most heavily infested with the parasite should be left untouched.

Creager (D. B.) & Spruijt (F. J.). **The Relation of certain Fungi to larval Development of** *Eumerus tuberculatus* **Rond. (Syrphidae, Diptera).**—*Ann. ent. Soc. Amer.* **28** no. 4 pp. 425–437, 1 pl., 5 figs., 11 refs. Columbus, Ohio, December 1935.

The following is taken from the authors' summary of investigations in New York in 1930 and 1931 on the relation of larvae of *Eumerus tuberculatus*, Rond., to the basal rot *Fusarium* and other fungi on narcissus bulbs. The growth of larvae free from micro-organisms was observed on diets of 3 types of sterile bulb media, namely, surface sterile tissue, autoclaved tissue and bulb-agar, with and without pure cultures of *Fusarium* and other fungi and bacteria. On all these media the presence of fungi was necessary for normal development. In the presence of *Fusarium* all the larvae matured rapidly. When living yeasts were used instead of *Fusarium*, the larvae developed more rapidly and became slightly larger, and when *Rhizopus nigricans* or *Mucor hiemalis* was substituted, the larvae also matured. With certain other fungi and bacteria, the larvae died before reaching maturity. When *Fusarium* was separated from the bulb and inactivated by autoclaving, the larvae were unable to complete their development. It was concluded that the larvae require the presence of certain living fungi, together with the bulb media, in order to complete their normal development.

Flanders (S. E.). **An apparent Correlation between the Feeding Habits of certain Pteromalids and the Condition of their ovarian Follicles (Pteromalidae, Hymenoptera).**—*Ann. ent. Soc. Amer.* **28** no. 4 pp. 438–444, 8 refs. Columbus, Ohio, December 1935.

The following is taken from the author's summary of observations made in 1933 and 1934 on four Pteromalid parasites of *Hypera* (*Phytonomus*) *variabilis*, Hbst., that have been introduced and liberated for the control of this weevil on lucerne in California. In certain Hymenopterous parasites, particularly the Pteromalids, *Dibrachoides*, *Peridesmia phytonomi*, Gah., *Spintherus*, and *Amblymerus* (*Eutelus*), a change occurs in the food habits of the female when the ovarian follicles reach a certain stage of development. In the laboratory, this change was from a diet of only cane sugar-syrup or of honey to a protein diet consisting of the body fluids of the host species. After the beginning of the period of egg deposition, a certain amount of carbohydrates appears to be needed in addition to the host's fluids. When environmental conditions inhibit oviposition, the ovarian follicles and the eggs apparently disintegrate and are absorbed and the parasite reverts to a purely carbohydrate diet. In *Peridesmia*, this may occur within 3 weeks after the first change in diet. This absorption of the contents of the ovaries (except the primary cells in the germarium) may also occur in females that did not develop a need for the host's fluids. A period of " phasic castration " follows, which may last as long as 9 months at temperatures between 65° and 80°F. The end of this period is apparently synchronised with the appearance in the field of the susceptible stage of the host.

Gaines (J. C.) & Campbell (F. L.). **Dyar's Rule as related to the Number of Instars of the Corn Ear Worm, *Heliothis obsoleta* (Fab.), collected in the Field.**—*Ann. ent. Soc. Amer.* **28** no. 4 pp. 445–461, 6 figs., 19 refs. Columbus, Ohio, December 1935.

The following is almost entirely from the authors' summary : The method of Peterson & Haeussler [*R.A.E.*, A **17** 178] of determining the number of instars in Lepidopterous larvae by collection of larvae representing all the instars of a generation, measurement of the width of head capsules of the individuals, and classification of the measurements in frequency-distribution diagrams, and its limitations are discussed. This method was used to determine the number of instars of 4 generations of *Heliothis armigera*, Hb. (*obsoleta*, F.) collected in Texas on susceptible crops. The first two generations were collected from maize, the third from maize and cotton, and the fourth from hegari [*Sorghum*]. These were the crops most susceptible to attack by the broods collected from them. The frequency distribution of the head measurements showed that the larvae from maize and hegari had 6 instars, whereas those from cotton had 7. It was thought that the larvae from cotton had an additional instar because this plant was less succulent than maize and hegari and consequently was less suitable for their development. Seasonal temperatures appeared to have no effect on the number of instars, for the spring and two summer generations from maize had the same number of instars. The application of Dyar's rule [*cf.* **20** 579, etc.] for corroborating the number of instars observed in *H. armigera* was studied mathematically. Four methods were used to calculate progressions for comparison with the observed progressions of mean head widths. The calculated geo-

metrical progressions were shown as straight lines on semilogarithmic cross-section paper. By the method of least squares and by calculation of the standard errors of estimate it was shown that the mean head widths of the first generation of *H. armigera* fitted a geometrical progression of 7 terms much better than one of 6 terms, the observed number. It was necessary to conclude either that the second instar of 7 was overlooked, or that Dyar's rule was not valid for this particular case. It was concluded that Dyar's rule did not hold, because the progression in question was not unusual, as shown by a study of the literature. High growth ratios are often encountered in the early part of larval development and there is a tendency for growth ratios to diminish during larval development. Examples from the literature are quoted to show that the application of Dyar's rule may indicate instars that do not exist, and its use for corroborating the number of instars observed is not recommended.

Schmidt (C. T.). **Biological Studies on the Nitidulid Beetles found in Pineapple Fields (Nitidulidae, Coleoptera).**—*Ann. ent. Soc. Amer.* **28** no. 4 pp. 475–511, 10 figs., 26 refs. Columbus, Ohio, December 1935.

The following is taken from the author's summary and conclusions : Of the six Nitidulids found in pineapple fields in Hawaii, *Carpophilus humeralis*, F., and *C. hemipterus*, L., are the most important, *C. maculatus*, Murr., and *Haptoncus ocularis*, Fairm., are less important and *C. dimidiatus*, F., and *H. mundus*, Sharp, are relatively rare. The abundance of these beetles seems to be related to the peculiar conditions of pineapple culture, which furnish suitable environments for their increase. None of the species is capable of inflicting primary injury, either directly or as vector of a disease of any part of the plant. Butt rot was not investigated. Their economic importance lies in the fact that they are a nuisance in the canning factories, where special precautions have to be taken to prevent them from getting into the tins of fruit. Both *C. humeralis* and *C. hemipterus* are shown to have a high potential of reproduction and a short immature period as compared with the length of life of the adult. *C. hemipterus* tends to be the more abundant in the early stages of decomposition of the plant trash and to be replaced by *C. humeralis* at later stages. The theoretical proposition of Volterra of any number of species competing for the same food cannot be applied to the present field study, since the numbers of the most important species present are controlled by mobility and migration factors rather than factors of reproduction and voracity. The influence of the Nitidulids in hastening decomposition can be measured definitely in terms of loss in dry weight. The increase which is evident in the early stages is lost in the later stages. The presence of the beetles gives no practical benefit in hastening the decomposition of trash in pineapple fields. Chemical determinations of the fractions of materials remaining in decomposing pineapple stumps indicate that no fraction is decomposed in excess of the other fractions.

Tucker (R. W. E.). **The Effect of Climatic Conditions on** *Diatraea saccharalis*.—*Agric. J. Barbados* **4** no. 3 pp. 114–128, 8 refs. Barbados, July 1935.

Observations made in Barbados in 1933, a year of good rainfall, and in 1934, a year of prolonged low rainfall, are recorded on the extent

of egg deposition of *Diatraea saccharalis*, F., on sugar-cane, the degree of destruction of eggs by predators and by *Trichogramma minutum*, Riley, the rate of larval survival, and the period of maximum emergence of the moths. The effect of climatic conditions, as demonstrated by these data, is shown to agree with experimental findings on the injurious effect of reduced humidity on *T. minutum* [*cf. R.A.E.*, A **22** 500]. Monthly plot records in 1934 as compared with 1933 show higher rates of larval mortality of *Diatraea*, particularly from July onwards, and in general a lower rate of parasitism by *T. minutum* in experimental blocks of sugar-cane, both colonised and uncolonised. Egg masses were frequently attacked by Psocid larvae and by a Gamasid mite, *Atomus* sp., but their activity decreased in 1934, and *Atomus* sp. was absent from mulched plots in which it had been numerous when they were unmulched in 1933.

Whereas in June and early July it is usual to find 5–6 times as many living larvae of *Diatraea* as living pupae, rather more pupae than larvae were found in early July in 1934, though the proportions tended to become less abnormal later on. This is attributed to the effect of drought and would tend to prevent too great an emergence of moths under rainless conditions and yet enable extra emergence when more favourable conditions arise. It would account for the low incidence of borers noticed in the field up to August, and the considerable amount of fresh borer damage in October. The normal expectation would have been that dry weather conditions would have decreased egg deposition, partly on account of reduced fecundity of the moths and partly because of the higher mortality of the larvae, but a comparison of the counts for 1933 and 1934 shows that, after a low start in the numbers of eggs for 1934, oviposition drew level in May 1934 and from then onwards was greater than in 1933.

VESEY-FITZGERALD (D.). **Further Notes on the Food and Habits of Trinidad Birds with special Reference to common Cane Field Birds.** —*Trop. Agriculture* **13** no. 1 pp. 12–18, 17 refs. Trinidad, January 1936.

Notes based on the examination of stomachs, as well as a few original notes on feeding habits, are given in respect of about 40 species of birds common in Trinidad, and particularly in sugar-cane fields. A large number of these are insectivorous and are shown to be of importance in controlling insect pests attacking sugar-cane.

STOREY (H. H.). **Report of the Plant Pathologist. Virus Diseases of Plants.**—*Rep. E. Afr. agric. Res. Sta. Amani* **7** 1934–35 pp. 12–16. London, H.M.S.O., 1935.

In the course of investigations at Amani in 1934–35 on the mechanism of transmission of the virus of streak disease of maize by *Cicadulina mbila*, Naudé [*cf. R.A.E.*, A **22** 11, 682], evidence was obtained that individual insects of the "active" race [*cf.* **21** 486] vary greatly in their ability to inoculate plants successfully during short contacts, as well as in their capacity to remain infective following a single contact with a source of virus. A normally fertile "active" line of *C. zeae*, China, proved to be infertile when crossed with a pure "inactive" race; microscopic examination has revealed minute morphological differences between the two races.

In experiments with two varieties of cassava received from the Gold Coast, where they are immune from mosaic disease or resistant to it, both varieties proved to be highly susceptible and were more severely damaged by the disease than the local ones, which tends to indicate that the strains of the mosaic virus may differ in West and East Africa. The selection of disease-free planting material appears to be the only measure that can be recommended at present ; experiments showed that cutting off the tops of plants as soon as symptoms of the disease appeared, or using only the bottom parts of stems for planting is useless for control.

KIRKPATRICK (T. W.). **Report of the Entomologist.**—*Rep. E. Afr. agric. Res. Sta. Amani* **7** 1934–35 pp. 16–18, 1 ref. London, H.M.S.O., 1935.

During January and February 1935, investigations near Moshi, Tanganyika, indicated that the relation between the standard climate and the eco-climate of coffee bushes, as ascertained in Kenya [*R.A.E.*, A **23** 423], hold good for a district with a somewhat different standard climate. Of two species of *Leucoptera* mining the leaves of coffee, one was prevalent in a cool, damp shaded situation and the other in a warmer, drier and more exposed one a few hundred yards away. Both species occurred together on the inner leaves of exposed bushes or the outer leaves of partly shaded ones. It has also been found that the coffee bug, *Antestia orbitalis lineaticollis*, Stål, is extensively parasitised by a species of Strepsiptera, probably belonging to a hitherto unknown family. It was observed in various parts of Tanganyika, sometimes attacking over 50 per cent. of the bugs. Though it caused little premature mortality, it rendered the females and possibly the males entirely sterile. It appears that it may be easily bred in captivity and may be of great value in reducing the rate of increase of *Antestia* during the intervals between applications of spray.

GOLDING (F. D.). **Locust Research in Nigeria.**—*Curr. Sci.* **4** no. 6 pp. 376–377. Bangalore, December 1935.

Most of the information in this article has already been noticed [*R.A.E.*, A **22** 619 ; **23** 49]. The ecological investigations carried out in the Chad area in 1934 and 1935 confirmed the suggestion that it is apparently unsuitable for the production of the *gregaria* phase of *Nomadacris septemfasciata*, Serv. It is intended in future to determine the range of *Nomadacris* in Nigeria, and to continue the study of the effect of climatic factors on movement and breeding of *Locusta migratoria migratorioides*, R. & F. [*cf.* **20** 97].

FERRIÈRE (C.). **Descriptions de deux importants Chalcidiens d'Egypte et du Soudan.**—*Bull. Soc. R. ent. Égypte* **19** pp. 365–370, 3 figs. Cairo, 1935.

One of the two new species described [*cf. R.A.E.*, B **24** 63] is *Elasmus platyedrae*, which appears to be one of the chief parasites of *Platyedra gossypiella*, Saund., in Egypt. Characters distinguishing it from *E. johnstoni*, Ferr., are given.

Bodenheimer (F. S.). **Animal Life in Palestine.**—Large Cr. 8vo, [6] 507 pp., 70 pls., 77 figs., many refs. Jerusalem, L. Mayer, 1935. Price £1 5*s*.

In this work on animal ecology and zoogeography in Palestine, 162 pages are devoted to insects and include a section on the principal insects of economic importance. A list records about 80 pests of *Citrus*, arranged according to the part of the plant attacked. The author states that this list is given not because the insects are of great economic importance in Palestine, but in order to show how an exotic plant is infested by both native and introduced insects.

Bouhelier (R.) & others. **La lutte contre les cochenilles nuisibles aux aurantiacées.**—[*Publ.*] *Déf. Cult. Dir. gén. Agric. Comm. Colon.* [*Morocco*] no. 6, 2nd edn, 58 pp., 10 figs., 2 pls., 13 refs. Rabat, October 1935. [Recd. January 1936.]

The first edition of this paper on the control of Coccids on *Citrus* in Morocco has already been noticed [*R.A.E.*, A **20** 451]. An extra section is devoted to the use of kerosene emulsions as sprays, and their effects on scale insects and plants.

Jourdan (M. L.). **Notes sur deux mouches parasites** *Clytiomyia* **et** *Gymnosoma* **(Larvaevoridae). I. Note complémentaire sur** *C. helluo* **Fab. parasite d'***Eurygaster austriaca* **Schrk. II.** *G. rotundatum* **L. parasite d'***Aelia triticiperda* **Pomel.**—*Encycl. ent.* B II Dipt. **8** pp. 117–119. Paris, 1935.

Studies on *Clytiomyia helluo*, F., a parasite of *Eurygaster austriaca*, Schr., in Morocco were continued in 1935 [*cf. R.A.E.*, A **23** 702]. Owing to the mild winter of 1934–35, the first adults of the Tachinid emerged about 10th February and those of the bug at the beginning of the month. The pupal stage of the first two generations of the parasite lasted from 10th to 28th March and from 29th April to 11th May, respectively. It breeds readily in the laboratory, and its introduction into localities where wheat is damaged by *E. austriaca* is being considered. The larva remains in the body of the host until it pupates. One female can parasitise 3–5 individuals. The adult flies did not live more than a week. They were observed in the field on flowers of *Euphorbia*. It was suggested [*loc. cit.*] that in nature the parasite continues to breed throughout the summer, but as *Eurygaster* undergoes a diapause for about 7 months starting in July and the life-cycles of the parasite and host are fairly similar, the former also may have a diapause.

The life-cycle of *Gymnosoma rotundatum*, L., is similar to that of *Clytiomyia*. The first adults of the overwintering generation emerge in February or March according to the season, at about the same time as the host, *Aelia triticiperda*, Pomel. The life-cycle of the first generation is longer (about 50 days) than that of the succeeding generations (about 30 days in June or July). The adults usually live about 4–7 days, but one lived for 16. As *A. triticiperda* has two generations a year, it is probable that *G. rotundatum* has more annual generations than *C. helluo*.

[Zimin (L. S.).] **Зимин (Л. С.). Le système de la tribu Tachinini (Diptera, Larvivoridae).** [*In Russian.*]—*Trav. Inst. zool. Acad. Sci. URSS.* **2** no. 2–3 pp. 509–636, 4 figs., 11 pls. Leningrad, 1935. (With a Summary in French.)

This work consists of two parts, the first of which opens with a discussion of the taxonomy of the genera and subgenera of the Tachinini. The author divides it into two subtribes, comprising 6 groups, the species of which are characterised by conformity in male genital armature, general morphology and geographical distribution. A description of the structure of the male genital armature in the tribe is followed by detailed descriptions of the external male genitalia of the individual genera and subgenera, with a key to them.

The second part comprises a revision of the Palaearctic species and contains descriptions of the genera, subgenera, 68 species and 3 subspecies, with keys and notes on geographical distribution. They include 3 new genera, 3 new subgenera, 16 new species and 1 new subspecies, all of which are described in French as well as Russian.

Marchal (P.), Trouvelot [B.], Dixmeras (—) & Grison (—). **Variabilité de l'attaque du doryphore sur diverses solanées tubérifères.**—*C. R. Acad. Agric. Fr.* **21** no. 31 pp. 1169–1175. Paris, 1935.

An account is given of experiments carried out in France since 1932 on the resistance to attack by the Colorado potato beetle [*Leptinotarsa decemlineata*, Say] of wild plants of the genus *Solanum* with a view to developing an immune variety of potato by cross breeding. The tests dealing with the feeding and oviposition of the adult beetles on these plants have already been noticed [*R.A.E.*, A **24** 77]. As a result of the number of eggs laid on it, 50 per cent. more larvae matured on *Solanum edinense* than on potato, and it was more severely damaged by them. It is, however, unsuitable for a trap plant, since statistical work shows that in the field it neither attracts nor retains many more adults than potato. On *S. caldasii*, the larvae tended to move about continually, so that the majority of the young ones fell off the plant and very few matured. The larvae remained on the leaves of *S. jamesii*, but after eating them turned black and died as if poisoned, as they do on *Petunia* [*cf.* **22** 665]. If gravid females that had fed previously on potato foliage oviposited on *S. commersonii*, the larvae hatched and died slowly after eating the leaves. Some varieties of this species give over 10 oz. tubers per plant, and are therefore promising for cross-breeding purposes. They might also be used for trap rows since, when fed on them, the adults do not reproduce and the larvae die. *S. demissum* is also resistant to the attack of the beetle, the behaviour of which on it is intermediate between that on *S. jamesii* and *S. commersonii*. Resistance depends considerably on the condition of each plant, but preliminary experiments on 7 hybrid plants obtained by crossing potato with *S. demissum* or *S. commersonii* showed that some had marked resistance to attack and others practically none.

Benson (R. B.). **The Alien Element in the British Sawfly Fauna.**—*Ann. appl. Biol.* **22** no. 4 pp. 754–768, 27 refs. Cambridge, November 1935.

A list is given of the introduced Tenthredinids of Britain, arranged under their food-plants, with notes on their history and distribution taken from the literature.

POTTER (C.). **An Account of the Constitution and Use of an atomised White Oil—Pyrethrum Fluid—to control** *Plodia interpunctella* **Hb. and** *Ephestia elutella* **Hb. in Warehouses.**—*Ann. appl. Biol.* **22** no. 4 pp. 769–805, 3 pls., 4 figs., 29 refs. Cambridge, November 1935.

A very detailed account is given of experiments on the use of an atomised spray of pyrethrum in oil for the control of *Ephestia elutella*, Hb., and *Plodia interpunctella*, Hb., infesting Australian dried fruit in London warehouses. The fruit is freed from infestation on arrival by an efficient system of barge fumigation, but the warehouses cannot be cleared by fumigation except at a prohibitive cost. The primary object of the spray is to kill the adults as they emerge in the spring and before they are able to lay eggs. *P. interpunctella* and *E. elutella* normally overwinter in London warehouses as full-grown hibernating larvae in cocoons in cracks or crevices, or in rare cases as young larvae in food materials. There is one generation a year in any floor except the top floor. During 1931–32, in 3 sets of experiments on the second floor of a five-floored warehouse, the average periods from egg to adult of *E. elutella* were 357, 367 and 366 days at average temperatures varying from 40·8°F. in February to 65·6°F. in July. Under these conditions hibernating larvae began to pupate in May and the adults emerged from early in June until the end of July. Adults of *P. interpunctella* emerge for the most part shortly after those of *E. elutella*, but the periods overlap. The moths emerge and pair at night. The eggs are laid either on the food material or between the boxes or sacks, and hatch in about 7 days. The young larvae eat their way into the block of fruit and sometimes enter individual fruits. From late August to the end of November, the larvae become fully grown and migrate in search of suitable crevices in which to spin cocoons. A few larvae, mainly those of *P. interpunctella*, remain in the food material, and some spin their cocoons inside or between the containers. Under conditions of high maximum temperatures prevailing in situations close to the roofs of single-storeyed sheds, the moths emerge early and there are two generations a year. In a single-storey warehouse all gradations occur between these warm conditions and the relatively cool conditions at ground level, which approximate those found in the middle floor of a several-storey warehouse, so that a great deal of overlapping of the various stages occurs.

The insecticide used consisted of 3 parts of a highly refined white oil (specific gravity 0·862; flash-point closed 320°F., open 335°F.; viscosity Redwood 1 at 70°F. 118 sec.; pour test 30°F.) mixed with 1 part of a similar oil containing 6·5 per cent. pyrethrins I and II. The oil resembles medicinal paraffin. Owing to the low volatility and high viscosity of the solution, the light protective film formed over the exposed surfaces remains effective for several weeks and kills moths and larvae coming in contact with it. This insecticide did not taint dried fruit or tobacco when tested, and is now used in warehouses containing both these products and stored cacao. Tests of inflammability showed that the finely divided spray does not form a combustible mixture with air.

A full description is given of the apparatus used and of the process employed against the moths and migrating larvae. The insecticide is atomised by means of guns or units working on the same principle and used in conjunction with them, both being worked by compressed air supplied by an air compressing machine at a pressure of about 65 lb. to

the square inch. An even coating of material was applied at a distance of 4 ft. with the nozzle adjusted to give the degree of atomisation used against the moths. When it was so set that one gun atomised 500 cc. in 45 minutes, the spray mist hung for 2 hours without clearing appreciably.

For dealing with adult moths a mist of finely atomised particles should hang for 1–2 hours. The mist is carried to all parts of the warehouse by the compressed air. It has an irritant effect upon the moths, causing them to fly, but eventually paralyses them and brings them to the floor, where the majority die. As some of the moths try to crawl to shelter or under the door, these places should be sprayed with a coarse spray before and after the operation. To ensure control of the moths, the warehouse must be treated every 24 hours throughout the period of emergence.

The technique described for use against the larvae is directed towards killing them when they are migrating. Warehouses from which infested goods have been taken may also be sprayed to kill any larvae that drop off during removal and threaten to cause re-infestation. Air pressures ranging between 30 and 65 lb. to the square inch are suitable for use against the larvae. The greater the air presssure the farther the spray will carry, but the larger the proportion of material that will be wasted. When the larvae are crawling over exposed surfaces, the nozzles are adjusted to a degree of atomisation as coarse as possible consistent with producing an even coating without staining. When larvae are moving in the interior of a pile of cases or sacks of goods, a fine degree of atomisation is used to penetrate the interstices. Wooden cases may be sprayed heavily without damage to the goods, the larvae being killed when driven from the interior of the pile. Sacks or fragile cases should be left for 20 minutes after the introduction of the fine mist, when most larvae will have reached the surface, after which the exterior is sprayed with rather fine atomisation. The floor round the edge of the pile should be heavily sprayed to kill larvae that drop off.

An account is given of a series of biological tests and observations made on the effect of the material and process on the adults and larvae of both species. It was found that the number of living moths present in infested premises is much greater than those seen on inspection, and that the atomised insecticide reaches and kills a percentage of the larger number. In 1933, the percentage of gravid females brought down was 91·36 for *P. interpunctella* and 83·50 for *E. elutella* when the period between atomisations was 4 days, so that with daily atomisations 100 per cent. kill of gravid females could be obtained. The percentage of newly emerged moths killed before their wings were fully expanded was 51·3 in 1933 and 56·9 in 1934. In two sheds the number of cases of infested goods requiring fumigation was reduced from 18,193 in 1935 to 95 in 1934, when daily atomisation was carried out during the period of emergence.

The larvae are very resistant to sprays and fumigants, those living under warehouse conditions being more resistant than those bred in the laboratory. Fully fed larvae at the beginning of the migratory phase appear to be more susceptible to sprays than they are toward the end of it when they are preparing to hibernate. The results of small scale experiments in November in which the spray was applied in about 33 seconds at the rate of 1 cc. per sq. ft. from a distance of $4\frac{1}{2}$ ft. showed that a strength of 0·81 per cent. pyrethrins in oil should

kill migratory larvae of *E. elutella* under any climatic conditions occurring in London warehouses. Although a good kill of *P. interpunctella* was obtained over a range of 0·54–1·63 per cent. pyrethrins, there is no margin of safety. The cost of using a higher percentage of pyrethrins would be prohibitive. When sheds were sprayed against moths during the early period of migration of the larvae, 42 per cent. of the latter died although not directly sprayed. In several instances, all larvae sprayed during warm weather died within a few days. In the tests in November, on the other hand, the majority of the larvae lingered on for several weeks in a moribund condition. At the high temperatures prevailing during the main migration period, the spray was therefore probably more effective than was shown in the tests.

THORPE (W. H.). **The Biology of** *Encyrtus* (*Comys*) *infelix*, **a remarkable Chalcid parasite of** *Lecanium hemisphaericum*.—*Proc. R. ent. Soc. Lond.* **10** pt. 2 pp. 62–63. London, 30th December 1935.

Eucomys (*Comys*) *infelix*, Embleton, is an internal parasite of the Coccid, *Saissetia coffeae*, Wlk. (*Lecanium hemisphaericum*, Targ.), a common pest of greenhouse plants in England. It is of especial interest owing to the extraordinary complexity of the relations between the parasite larva and host. The respiratory adaptations in particular are perhaps the most remarkable known among parasitic insects.

The chorion of the egg is prolonged to form a hollow stalk, which projects through the skin of the host and which enables the early (metapneustic) larval stages, within the body cavity, to utilise atmospheric oxygen. Later a totally different method of respiration supervenes. The connection with the egg stalk is broken, and the larva (now amphipneustic) becomes closely invested by a membranous sheath produced by the host. This sheath becomes fused on to the main tracheal trunks of the host in four places, so that ultimately a connection is established between the cavity of the sheath and the lumen of the host tracheal system. The parasite is thus enabled to utilise the air contained in the respiratory system of the scale insect.

POTTER (C.). **The Biology and Distribution of** *Rhizopertha dominica* (**Fab.**).—*Trans. R. ent. Soc. Lond.* **83** pt. 4 pp. 449–482, 25 figs., 3 pp. refs. London, 30th December 1935.

An account is given from the literature of the systematic position and distribution of the Bostrychid, *Rhizopertha dominica*, F., with a list of the records of its occurrence classified under zoogeographical regions. It has been introduced all over the world, but the areas where it can exist throughout the year under natural conditions lie between latitudes 40° N. and 40° S. It probably originated from India or the Indian subregion. A list is given of the substances on which it has been recorded to feed. It is most important as a pest of stored grain, particularly in India, Argentina, the United States and New South Wales, and has also been recorded as attacking wood. Its original food was probably wood, possibly of living trees. Grain may be so badly attacked that only a thin shell remains, and several beetles may be found in one grain of maize. Though it has been stated that the larvae are only able to attack damaged grains, first instar larvae in the laboratory entered an intact maize grain through the hard testa.

It is probable that the other stages would not be able to do so, although nearly full-grown larvae penetrated the cork of a tube in which they were confined.

The method of rearing, killing, and examining the stages in the laboratory is briefly described. The first-instar larvae were fed on a piece of maize grain and the succeeding instars, which are incapable of moving far, were fed with small amounts of synthetic wholemeal flour. In the absence of abundant food, the life-cycle of the larva was prolonged, it moulted more often, and did not grow so large. If food was given sparingly to a larva in its later stages, it died. By correlating observations on the life-history of 10 larvae reared to maturity on synthetic wholemeal flour with those made on larvae dissected from whole grains, a fairly accurate account of the life-history was obtained. The 10 larvae were kept singly in small tubes in an incubator at 26°C. [78·8°F.] and about 65 per cent. relative humidity between 12th October 1931 and 12th January 1932. The eggs were laid in batches (up to 30 but 2–5 frequently found) on the grain, loose and usually singly among the frass, or in batches attached to the sides of the vessel in which the beetles were kept. Newly hatched larvae survived on wholemeal flour but died on white flour. The eggs were most often deposited under the paleae at the embryonic end of the grain, which is the softest and most nutritive part. The incubation period varies with the climatic conditions and possibly the time of year; it was 12–18 days at 26°C. [78·8°F.] and less at 30°C. [86°F.]. An active campodeiform larva hatches from the egg and burrows into the grain at any convenient point of entry; a larva that has entered a grain remains there for the rest of its life. According to P. Lesne the larva moults 4 or 5 times, but in the experiments with wholemeal flour the usual number of moults was 3 and there was always a prepupal stage. The lengths of the various instars at 26°C. [78·8°F.] were about 21, 11, 10 and 10 days, respectively. In one case a fourth moult occurred 5 days after the third, and the prepupal stage was reached 10 days later. In another instance the larva only moulted twice, and entered the prepupal stage 9 days later. The second instar larvae are less active than the first and those of the succeeding instars seem unable to move about on a flat surface. The prepupal stage occupies about $1\frac{1}{2}$ days and the pupal $6\frac{1}{2}$. The pupal is the first stage in the life-history during which it is possible to distinguish the sexes. The total length of the life-cycle from egg to adult averaged 58 days. At 30°C. [86°F.] and about 30 per cent. relative humidity, it took 30–40 days between September and November. In the laboratory from the beginning of June to the end of August, the beetles flew when exposed to light. Although kept under constant conditions of temperature and humidity, they developed more rapidly in the summer.

The immature stages, the characters distinguishing the sexes in the pupal stage, the mature larva, the adult, and the genitalia of both sexes are described in detail; and the importance of the genitalia in phylogeny is discussed.

Natural enemies include fungi, predacious mites and Hymenopterous parasites, of which the most important is *Lariophagus distinguendus*, Först. [*cf. R.A.E.*, A **10** 106]. *Rhizopertha* does not flourish in a culture that has become mouldy. It does not induce mouldiness in the grain as *Calandra* spp. do, and does not seem to be able to combat mould so well. Predacious mites may destroy many or all the eggs

and larvae in a culture, but they are not serious enemies under natural conditions. Beetles in the incubator were attacked by *Cheyletus eruditus*, Schr.

Hey (G. L.). **The Control of Capsids by Winter Spraying. With Notes on " Red Spider " Control.**—*Fruit Grower* 2nd January 1936 reprint 4 pp., 4 refs. London, 1936.

In large scale field trials on the control of Capsids, carried out in England in 1934 and 1935, the miscible type of petroleum oil spray gave slightly better control than the emulsion type. The only difference between the two oils was in the method of emulsification. The average reduction in infestation of black currant and 10 varieties of apples in 18 trials in 8 districts was 94 per cent. for the miscible type of wash and 89 per cent. for the emulsion type. In all cases but one a 10 per cent. wash was applied in February or a 7½ per cent. wash in March. The washes conformed to the specifications given by Martin [*cf. R.A.E.*, A **23** 497] for petroleum oil preparations Grade E, M.O. or S.E.1. The miscible type is easier to dilute, more stable to frost and storage, and more visible on the tree than the emulsion type, but the latter is more readily mixed with hard or saline waters. It is recommended that a 10 per cent. spray should be applied in February or a 7½ per cent. spray in the last three weeks of March, or even in early April before the Capsids hatch. These sprays very rarely injure the trees, the miscible type probably slightly less than the emulsion type.

When the miscible type petroleum oil at a concentration of 7½ per cent. was applied to apples with undercrops of gooseberries and black currants, gooseberries, and nuts that were already set, on 14th March 1935, 20th–21st March 1934, and 23rd March–1st April 1935 respectively, the undercrops were uninjured. The same spray applied at the end of March to apples interplanted with plums caused severe damage to the latter, but applied a week earlier in the same district did not harm them. The application of the emulsion type of petroleum oil spray in mid-March damaged an undercrop of narcissus. Mixed washes containing petroleum and tar oils are more injurious to all undercrops except black currants. They should be applied at a concentration of 10 per cent. to apples and black currants not later than the end of February, and to plums not later than the end of January. Petroleum and mixed tar-petroleum sprays also give good control of the red spider [*Paratetranychus pilosus*, C. & F.] when applied as late as possible. A 7½ per cent. petroleum wash should be applied to apples in the last 3 weeks of March and to pears, plums and damsons a month earlier. A tar oil wash followed by a petroleum wash, in January for pears, plums and damsons and in February for apples, is better than a mixed tar-petroleum wash at a concentration of 10 per cent. Higher dilutions of the mixed spray do not give effective control.

All trees should be sprayed thoroughly, and in fair weather.

Gunn (D. L.) & Notley (F. B.). **The Temperature and Humidity Relations of the Cockroach. iv. Thermal Death-point.**—*J. exp. Biol.* **13** no. 1 pp. 28–34, 4 figs., 14 refs. London, January 1936.

This paper, which is one of a series [*cf. R.A.E.*, A **23** 272], records an investigation of the thermal death-points of *Periplaneta americana*, L., *Blatta orientalis*, L., and *Blatella germanica*, L., in dry and in moist

air for exposures of 1 day and 1 hour. For all three cockroaches moist air was more favourable than dry in the longer exposures, because in dry air death occurred from desiccation when the temperature itself was not fatal, whereas in the shorter exposures dry air was the more favourable, because evaporation of water lowered the body temperature.

DAVIDSON (J.). **Climate in Relation to Insect Ecology in Australia. 1. Mean monthly Precipitation and Atmospheric Saturation Deficit in Australia.**—*Trans. roy. Soc. S. Aust.* **58** pp. 197–210, 12 charts, 3 refs. Adelaide, 1934. **2. Mean Monthly Temperature and Precipitation-Evaporation Ratio.**—*Op. cit.* **59** pp. 107–124, 12 charts, 8 refs. 1935.

In these papers the climate of Australia is studied with respect to factors of importance in insect ecology. Maps show the distribution for each month of mean rainfall, mean vapour pressure saturation deficiency, mean temperature, and ratio of mean rainfall (recorded) to evaporation (calculated). Precipitation-evaporation ratios are discussed and compared with the indices of aridity for certain localities.

VEITCH (R.). **Report of the Chief Entomologist.**—*Rep. Dep. Agric. Qd 1934–35* pp. 68–72, 22 refs. Brisbane, 1935.

An outbreak of *Chortoicetes* (*Calataria*) *terminifera*, Wlk., occurred in the south and centre of Queensland in 1934 and early 1935. Abnormal numbers of hoppers hatched in September, and by January the infestation began to decline, partly owing to the use of baits [*cf. R.A.E.*, A **23** 116] and partly from the action of natural enemies, including the egg parasite, *Scelio fulgidus*, Crwf., two species of Tachinids and the predatory wasp, *Polistes schach*, F. Although tobacco was not injured by *C. terminifera*, it was damaged by *Phaulacridium gemini*, Sjöst., in some districts. The ordinary bait system was ineffective for this species. Other grasshoppers have also been abundant in the north west for the last two years, particularly *Gastrimargus musicus*, F., and *Austracris proxima*, Wlk. An area of 25,000 acres of grassland in northern Queensland is infested with the white grub, *Lepidiota caudata*, Blackb. ; *L. laevis*, Arrow, is still confined to a few localities, and *Oncopera mitocera*, Turner, does little damage. A colony of the American toad, *Bufo marinus*, has been introduced against white grubs in the sugar-cane districts.

The investigation on *Phthorimaea operculella*, Zell., and *P. heliopa*, Lw., on tobacco has been concluded. The colloidal copper or copper emulsion sprays employed against blue mould, together with regular dusting with lead arsenate, greatly reduce infestation of seedlings by these insects. First experiments on the concentration of carbon bisulphide necessary to fumigate potatoes against *P. operculella* indicate that it is very small compared with that recommended in other countries. Preliminary tests on the control of *Nezara viridula*, L., on tomatos showed that a modified spray containing resin, caustic soda and fish oil should be satisfactory and would not injure the tomatos.

Spraying experiments for the control of *Dacus ferrugineus*, F. (*Chaetodacus tryoni*, Frogg.) in orchards were disturbed by weather conditions, but nevertheless they showed that mixed sprays of nicotine sulphate and white oil [*cf.* **23** 116] gave better protection to the fruit

than sprays containing white oil only, or colloidal sulphur. The banana thrips, *Scirtothrips signipennis*, Bagn., was found breeding on *Citrus*, particularly oranges. The infestation by this thrips on bananas has declined in the last two years, probably temporarily [*cf.* **23** 164]. Nicotine dusts gave excellent control when applied weekly, and good control when applied fortnightly, and derris dusts gave comparable results. There was some silvering of banana leaves probably caused by *Thrips imaginis* Bagn.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **46** pt. 11 pp. 639–642, 8 figs. Sydney, 1st November 1935.

The insect pests in New South Wales dealt with in this part of a series [*cf. R.A.E.*, A **23** 720] include *Tortrix postvittana*, Wlk., which is a widely distributed indigenous species attacking apples, pears, oranges and grape-vines, as well as a wide range of native food-plants. In addition to injuring the foliage, the larvae sometimes feed on the surface of apple and orange fruits and occasionally tunnel more deeply into the fruit. They may be destroyed by spraying with lead arsenate (1½ lb. to 50 gals. water). *Nezara viridula*, L., may be effectively controlled on green vegetables, especially beans and tomatos, by applications of pyrethrum dust alone or mixed with an equal quantity of 21 per cent. nicotine. Both the foliage and soil round the plants should be treated.

Robertson (W. C.). **Lead Arsenates—Analyses of Samples, 1935–1936.**—*J. Dep. Agric. Vict.* **33** pt. 11 pp. 538–541, 3 figs. Melbourne, November 1935.

In addition to recording results of analyses of samples of 14 proprietary brands of lead arsenate and comparing them briefly with those obtained in the previous season [*R.A.E.*, A **22** 712], this paper gives short notes on the compatibility of lead arsenate with other insecticides and fungicides.

Qadri (A. H.). *Rhogas aligharensi* **sp. n. (A Pink Boll-worm Parasite).**—*Curr. Sci.* **2** no. 6 p. 209. Bangalore, December 1933. [Recd. December 1935.]

Larvae of *Platyedra gossypiella*, Saund., collected from cotton fields at Aligarh (United Provinces) were found to be parasitised by a new Braconid, here described as *Rhogas aligharensi*.

Beeson (C. F. C.) & Chatterjee (S. N.). **On the Biology of the Braconidae (Hymenopt.).**—*Indian For. Rec.* N.S. **1** no. 6 pp. 105–138, 2 figs., 1 pl. Delhi, November 1935. **On the Biology of the Ichneumonidae (Hymenoptera).**—*T.c.* no. 8 pp. 151–168, 3 figs. December 1935. **On the Biology of the Tachinidae (Diptera).**—*T.c.* no. 9 pp. 169–184, 2 figs. November 1935.

These papers contain lists of parasites of forest insects that occur in India, the parasites being arranged in alphabetical order, with notes on their hosts, distribution and biology. They deal with 70 Braconids, 50 Ichneumonids and 41 Tachinids, a few of which are not found in India but occur in neighbouring countries. An addendum to the first paper contains notes by P. M. Glover on 4 Braconid parasites of Lepidopetra that are predacious on the lac insect (*Laccifer lacca*, Kerr).

Voûte (A. D.). *Cryptorrhynchus gravis* **F. und die Ursachen seiner Massenvermehrung in Java.** [*C. gravis* and the Causes of its Multiplication in Java.]—*Arch. néerl. Zool.* **2** no. 1 pp. 112–142, 5 graphs, 17 refs. Leiden, 1935.

An account is given of field and laboratory observations during 1929–32 in Java on *Cryptorrhynchus gravis*, F., which is a pest of mango in Sumatra, Java, Borneo, Banka, Bali and possibly other islands, but has not been recorded from Celebes. The eggs are laid, generally over a period of 5 weeks, on the surface of half ripe fruit, the weevils making holes in the skin to facilitate entry by the larvae. In the Buitenzorg district the egg, larval and pupal stages lasted 5½–7, 30–36 and 5 days, respectively. In warmer and drier districts the life-cycle requires some days less. Development took place entirely within the fruit, which was abandoned only when it was ripe. The biology of the weevil in Java differs little from that in India [*cf. R.A.E.*, A **11** 544]. Humidity has more effect than temperature on the length of adult life. Of 34 very young weevils exposed during the dry monsoon all died within 2 weeks, but of 10 that were 9 months old 6 were alive after 4 weeks. Climate had little effect on egg or larval mortality, which depended rather on conditions of overcrowding and on the variety of mango. The average percentage mortalities of eggs and larvae were, respectively, 35 and 38, 32 and 33, 50 and 41, and 42 and 58 in a variety of *Mangifera indica*, two varieties of *M. odorata* and one of *M. foetica*. A test as to which variety was preferred for oviposition showed the first three to be equally attractive and the last very much less so. Weevils that did not pair or oviposit lived more than a year, but those that paired died soon after completing oviposition. They did not show a tendency to spread from tree to tree unless these were closely planted ; trees a short distance from infested ones remained free from attack. Conditions conducive to mass multiplication of the weevil are a district with a damp warm climate and one or more of the 3 favoured varieties of mango growing close together in large numbers and blooming at least once a year. The only effective natural enemy is the ant, *Oecophylla smaragdina*, F., which destroys or drives away all other insects on any tree on which it builds its nest.

Corbett (G. H.). **Malayan Aleurodidae.**—*J. F.M.S. Mus.* **17** pt. 4 pp. 722–852, 105 figs. Singapore, 1935.

This revision of Malayan Aleurodids comprises 124 species, of which 91 are described as new. The food-plants and local distribution of each are indicated. Indices are given to the species, arranged under genera, and to the food-plants showing the Aleurodids that attack them.

Lou (Hoai-pao). **Recherches sur la Faune aphidologique de la Chine.**—Roy. 8vo, 125 pp., 6 figs., 12 pp. refs. Lyon, Bosc Frères, M. & L. Riou, 1935.

This work comprises a revision of the Aphids of China, showing their food-plants and world distribution, a general discussion of the characters of the Aphid fauna of the Far East, and an alphabetical list of the food-plants of the Chinese Aphids, showing the species attacking each.

PAPERS NOTICED BY TITLE ONLY.

CHABOUSSOU (F.). **Les Myriapodes dans leurs rapports avec l'agriculture.** [A review of the literature.]—*Rev. Zool. agric.* **34** nos. 9–12 pp. 133–140, 156–162, 167–177, 181–196; 13 figs., many refs. Bordeaux, 1935.

YAGO (M.). **Description of** [the sexual forms of] *Nippocallis* [*Chromophis*] *kuricola* **Mats., a Pest of Chestnut.** [*In Japanese.*]—*J. Plant Prot.* **23** no. 1 pp. 71–73, 1 pl. Tokyo, January 1936.

SHINJI (O.). **Key to Japanese Species of** *Agrioaphis* [*Myzocallis*]**, with 3 new Species.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **7** no. 6 pp. 281–287, 1 fig. Tokyo, December 1935.

SHINJI (O.). **Two new Species of non-Diaspine Coccidae from the north-eastern Part of Honshu.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **7** no. 6 pp. 288–290, 2 figs. Tokyo, December 1935.

SHINJI (O.). **A List of the Unarmoured Scale Insects collected in the Prefecture of Iwate, with the Descriptions** [in English] **of 7 new Species.** [*In Japanese.*]—*Dobuts. Zasshi* **47** no. 566 pp. 767–776, 1 pl., 1 fig. Tokyo, December 1935.

GOUX (L.). **Notes sur les Coccides (Hem.) de la France (12e note). Etude d'une** *Ehrhornia* **nouvelle** [*E. fodiens*, sp. n. on *Juniperus communis*].—*Bull. Soc. ent. Fr.* **40** no. 18 pp. 254–259, 15 figs. Paris, 1935.

MUNRO (H. K.). **Observations and Comments on the Trypetidae (Dipt.) of Formosa.**—*Arb. physiol. angew. Ent. Berl.* **2** nos. 3–4, pp. 195–203, 253–271, 1 fig., 26 refs. Berlin, 20th September and 21st December 1935.

EIDMANN (H.). **Der Stand der Forstentomologie in Deutschland.** [The Position of Forest Entomology in Germany (an historical survey).]—*Arb. physiol. angew. Ent. Berl.* **2** no. 4 pp. 282–288. Berlin, 21st December 1935.

RIETSCHEL (P.). **Ueber zwei Parasiten von** *Tenebrio molitor* [Two Parasites of *T. molitor*, L. (the myxomycete, *Sporomyxa tenebrionis*, sp. n., and the sporozoon, *Adelina tenebrionis*).]—*Arch. Protistenk.* **86** no. 2 pp. 349–358, 5 figs., 5 refs. Jena, 30th December 1935.

METALNIKOV (S.) & METALNIKOV (S. S.). **Utilisation des microbes dans la lutte contre les insectes nuisibles.** [A review of the literature.]—*Ann. Inst. Pasteur* **55** no. 6 pp. 709–760, 5 figs., 53 refs. Paris, December 1935.

[MEĬER (MEYER) (N. F.).] **Мейер (Н. Ф.). Tables systématiques des Hyménoptères parasites (fam. Ichneumonidae) de l'U.R.S.S. et des Pays limitrophes.** [*In Russian.*]—*Tabl. anal. Faune URSS.* **1** no. 9 458 pp., 24 figs., 1933; **2** no. 15 325 pp., 21 figs., 1933; **3** no. 15 671 pp., 22 figs., 1934; **4** no. 16 535 pp., 32 figs., 1935. Leningrad, Inst. zool. Acad. Sci., 1933–35.

HANNA (A. D.). **The Morphology and Anatomy of** *Euchalcidia caryobori* **Hanna (Hymenoptera-Chalcidinae).**—*Bull. Soc. R. ent. Égypte* **19** pp. 326–364, 51 figs., 19 refs. Cairo, 1935.

Krasucki (A.). **Studja nad niezmiarką**—*Chlorops pumilionis* **Bjer.** [Studies on *C. taeniopus* Mg., in Poland.]—*Pamiętnik państw. Inst. nauk. Gosp. wiejsk. Puławach* (*Mém. Inst. polon. Econ. rur.*) **14** pp. 1–86, 6 graphs, 7 pls. (4 fldg), 88 refs. Puławy, 1933. (With a Summary in German.) [Recd. January 1936.] [*See R.A.E.*, A **23** 347.]

Heller (K. M.). **Ein neuer Rüsselkafer aus peruanischen Kartoffeln.** [A new Weevil, *Plastoleptops solanivorax*, gen. et sp. n., from Potato in Peru.]—*Arb. physiol. angew. Ent. Berl.* **2** no. 4 pp. 276–278, 4 figs. Berlin, 21st December 1935.

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Neiswander (R. B.). **The Alimentary Canal of the Oriental Fruit Moth Larva** [*Cydia molesta*, Busck].—*Ohio J. Sci.* **35** no. 6 pp. 434–439, 2 pls., 5 refs. Columbus, Ohio, November 1935.

Phillips (W. J.) & Barber (G. W.). **The Corn Earworm** [*Heliothis armigera*, Hb.] **as an enemy of Field Corn** [Maize] **in the Eastern States.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1651 revd, 17 pp., 17 figs. Washington, D.C., March 1935. [Recd. January 1936.] [*Cf. R.A.E.*, A **11** 380 ; **19** 310.]

Walton (W. R.). **How to detect Outbreaks of Insects and save the Grain Crops.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 835 revd, 20 pp., 14 figs., 7 refs. Washington, D.C., March 1935. [Recd. January 1936.] [*Cf. R.A.E.*, A **6** 14 ; **19** 760.]

Back (E. A.). **Clothes Moths and their Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1353 revd, 29 pp., 19 figs., 2 refs. Washington, D.C., May 1935. [Recd. January 1936.] [*Cf. R.A.E.*, A **11** 570 ; **21** 40.]

Duspiva (F.) & Linderstrøm-Lang (K.). **Die Keratinverdauung der Larven von** *Tineola biselliella.* [Digestion of Keratin by the Larva of *T. biselliella*, Humm.]—*Verh. dtsch. zool. Ges.* **37** pp. 126–131, 8 refs. Leipzig, December 1935.

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Fluke (C. L.), Dunn (E. P.) & Ritcher (P. O.). **Silicates of Soda incorporated with Lead Arsenate in the last regular Spray an Aid to Residue Removal.**—*J. econ. Ent.* **28** no. 6 pp. 1056–1058. Geneva, N.Y., December 1935. [*Cf. R.A.E.*, A **24** 64.]

Hoyer (D. G.) & Weed (A.). **Pyrocatechin as a protecting Agent for the active Principles of Pyrethrum in finished Fly-Sprays and Concentrates.**—*J. econ. Ent.* **28** no. 6 pp. 1074–1075, 1 ref. Geneva, N.Y., December 1935. [*See R.A.E.*, B **24** 63.]

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